ALLAN HANCOCK ATLANTIC EXPEDITION

REPORT NUMBER 1

GEOGRAPHICAL ACCOUNT AND STATION RECORDS OF *VELERO III* IN ATLANTIC WATERS IN 1939

(PLATES 1-28)

BY

JOHN S. GARTH
ALLAN HANCOCK FOUNDATION

THE UNIVERSITY OF SOUTHERN CALIFORNIA
LOS ANGELES, CALIFORNIA
1945

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INTRODUCTORY REMARKS

For nearly a decade, while the *Velero III* cruised up and down the Pacific coast of Central and South America, it had been in the mind of Captain Hancock to make a voyage of exploration into Atlantic waters. For, with the exception of the day necessarily consumed in the transit of the Panama Canal, the east coast of South America is as accessible from Balboa as the west coast. Up until 1939, however, the tendency to return to familiar scenes of endeavor had served as a deterrent to any departure from Pacific exploration, no matter how readily accomplished.

The occasion for the new venture presented itself in April of 1939, when it was decided to forego another visit to the coasts of Ecuador and Peru in favor of the Atlantic coast of Colombia and Venezuela. Thus, the geographical objective became the Pitch Lake of Trinidad in place of the brea pits of Santa Elena.

The scientists, of course, had other objectives. The opportunity of obtaining east coast material to compare with the already large west coast collections was eagerly seized upon by those of the staff whose entire collecting experience had been restricted to Pacific waters. Others with previous collecting experience at Woods Hole, Massachusetts, and at the Tortugas laboratories in Florida regarded most highly the opportunity to visit a portion of the Atlantic coast along which little marine biological work had been done. This was particularly true of the bight leading to the Gulf of Darien, a region seldom seen by travelers on the commercial vessels that shuttle between Cristobal and Cartagena by the most direct route possible.

Since the history of the Expeditions and the description of the *Velero III* have been thoroughly covered by Fraser (Vol. 1, No. 1), they need not be repeated. As to personnel, the scientific party that began the Pacific portion of the cruise was augmented by Dr. Waldo L. Schmitt of the U.S. National Museum, who joined the ship at Balboa, and by Dr. Harry M. Wegeforth, San Diego Zoological Society president and ship's sur-

geon, who came aboard at Port of Spain with a consignment of live animals from Brazil. For the reader's easy reference, the remainder of the scientific staff consisted of Dr. Wm. R. Taylor of the University of Michigan, Messrs. Karl Koch and C. B. Perkins of the San Diego Zoological Society, and Messrs. Granville P. Ashcraft, Francis H. Elmore, John S. Garth, J. Alex Hill, Chester L. Hogan, Charles B. Wade, and Fred C. Ziesenhenne of the Hancock Expeditions staff.

In conformity with the pattern set by Volume 1, Number 2, a running description of the coast line from Cristobal to Port of Spain has been attempted as a background to the station list which follows. Actually, the localities visited by the *Velero III,* being sporadically placed and arbitrarily chosen, do not justify this treatment to the same degree as in the Pacific, where repeated journeys along the same coast line gave opportunity to fill in large gaps originally left between stations. A second cruise, substituting a stop at Cartagena or Santa Marta for the one at Barranquilla, where no marine work was possible, a stop at Puerto Cabello for the one at La Guaira, where port regulations proved restraining, and a visit to the Venezuelan islands of Orchilla, Los Roques, and Las Aves instead of Tortuga, Coche, and Cubagua, would have been highly desirable in order to round out the station record. Such a cruise might have eventuated had not the *Velero III* been pressed into government service in the fall of 1941. Some paragraphs of description are devoted to localities omitted from the itinerary in the hope that they may catch the eye of someone possessed of the facilities to explore them. The greatest detail, however, is reserved for those stops at which the *Velero III* made actual collections, and to the local conditions under which such collections were made.

The Central America and Mexico Coast Pilot (East Coast) (H. O. No. 130) and *Sailing Directions for the West Indies,* Volume II (H. O. No. 129), have been consulted wherever necessary to supplement original observations, and have of necessity become standards for orthography, since no complete listing of place names is otherwise available. The survey charts of the U.S. Hydrographic Office have been referred to for distances and elevations. The log of the *Velero III* has contributed notations on weather, anchorage positions, and depths. Photographs of the coast line, and particularly of collecting grounds, have also been considered source material.

To provide the research student with a more nearly complete and coherent picture of environmental conditions than is usually afforded by the brief notations included as specimen data has been considered the

primary purpose of the geographical account. If the word "mud" appears often in describing the ocean bottom, or if "northeast trades" or "westerly directed currents" seem unduly emphasized in describing surface and subsurface conditions, the reason is not only that these factors conditioned the activities of the field workers during the entire month in which collections were being made but that, operating over infinitely longer periods, they cannot but have been effective forces in conditioning the marine biota of the southern Caribbean region.

THE CARIBBEAN AREA

The southern Caribbean has certain general characteristics as to wind, land and sea temperatures, humidity, rainfall, and ocean currents which, if presented at the outset, will not require later discussion. The region is remarkably uniform in respect to the first of these, being entirely within the latitudes of the northeast trade winds. It may be taken as axiomatic that a vessel working eastward along the north coast of South America will encounter head winds varying in direction from northeast to east. It is the November-to-April period in which the winds blow most steadily, or from 70 to 90 per cent of the time. The velocity of the wind is least in October, just before the onset of the November-to-April period, and greatest, at least in the southwest Caribbean, in May, June, and July. This may account for a statement made by a Magdalena River Pilot that the season of the northeast trades was nearer seven months than five in the Barranquilla region. Wind velocity is greatest at noon, or shortly thereafter, and least at sunrise, a fact that was taken advantage of by the *Velero III* in dredging operations at Cape la Vela.

Air temperatures are also remarkably uniform, with an annual mean for sea-level stations of 79° to 81° F. September and May are warm months, with mean temperatures of 81° to 83° F., while January and February are cooler, with 76° to 78° F. mean temperatures. Extreme high temperatures of 100° F. or low temperatures of 55° F. are seldom encountered near the coast. These general figures for the entire region would seem to be borne out by *Velero III* observations, all made in the month of April, when air temperatures ranging from 70° to 84° F. were encountered at sea or in open anchorage. A 90° F. temperature recorded at Caledonia Bay, Panama, may be accounted for in part by the distance of the anchorage from open ocean, and a 99° F. figure at Barranquilla, Colombia, by the heat reflected from the steel surfaces of the ship and adjacent steel and concrete wharves.

Surface water temperatures over the southern Caribbean region vary from an average of 78° F. in February and March to an average of 83° F. in September or October. In the northern Caribbean these figures are approximately one degree less. *Velero III* readings in April ranged from 70° F. off Coche Island, Venezuela, to 78° F. off Galera Point, Trinidad, with an average of 73.84° F. for nine observations, a figure fully four degrees cooler than might have been expected according to the general averages given above.

Humidity data are available for only some of the islands. The monthly mean for the dry season, February to April, is 60 per cent saturation. The monthly mean for the wet season, October and November, is 84 per cent. Early morning humidity may reach 92 per cent, as at Fort de France, Martinique, but drops off during the sunlight hours to 81 per cent (October and November readings).

Rainfall is the most variable of the factors yet considered. Average annual rainfall varies from 20½ inches for the arid section of Venezuela including Lake Maracaibo and the Dutch West Indies to over 100 inches along the north coast of Trinidad. The dry season is from December to April, with May included in the Gulf of Venezuela. It thus coincides with, or follows shortly after, the period of steady northeast winds. From May on, the frequency of rains increases, culminating in the late summer or early autumn months of August and September and decreasing through October and November.

In conclusion, it will be seen that the Caribbean region is one of high average temperatures and humidity, the oppressive effects of which are mitigated by the steady and dependable trade winds which exercise a moderating influence except where prevented by local conditions. The entire region is free from fog, but cloudiness is common as a prelude to the rains of the late summer period.

The general path of the tropical hurricanes which scourge the northern and eastern Caribbean islands is from southeast to northwest, with a tendency toward deflection to the north or east in the higher latitudes. Either the Barbados-Haiti-Cuba axis may be followed to New Orleans or the Barbuda-Puerto-Bahamas axis to Miami, with devastating results to palm groves and sugar plantations. Of the seven historic storms the courses of which are plotted in *Sailing Directions for the West Indies,* only that of June 27-July 6, 1933, entered the Caribbean at a latitude low enough to affect Trinidad and eastern Venezuela, and only that of November, 1932, dipped near enough to the South American coast to be felt at Cape la Vela, Colombia. For complete discussion of these cyclonic storms the reader is referred to the above-mentioned *Sailing Directions.*

The south equatorial current, originating in the Gulf of Guinea on the west African coast, crosses the Atlantic in the region of the equator, striking the South American east coast north of Natal and proceeding in a northwesterly direction along the coast of Brazil and the Guianas at a speed of 1½ to 2 knots. Off Trinidad it enters the Caribbean by the Gulf of Paria, by the strait between Trinidad and Tobago, where it attains a maximum velocity of 3 knots, and by the passageways between the Lesser Antilles, with diminishing force, as far north as Martinique. The current proceeds in a westerly direction along the north coast of Venezuela, its maximum speed, 1½ knots, being felt along the fringe of outlying islands or in the channels between them and the mainland. From Cape la Vela westward its speed and force diminish as it expands into the widest portion of the Caribbean. Reaching the Magdalena River, it is deflected to the northwestward by the volume of fresh water issuing from that stream and by a slower countercurrent originating in the Gulf of Darien and proceeding close inshore to Cartagena and beyond. A similar countercurrent also occurs along the Venezuela coast south of the offshore islands. Since local topography may considerably alter both speed and direction of currents, exceptions to this general scheme will be noted from time to time in the account that follows.

The general plan will be to describe the coast line from Panama east to Trinidad, including the inshore islands of Tortuga, Cubagua, Coche, and Margarita. Following this, the offshore islands will be considered, beginning with the most easterly, Los Hermanos, and proceeding in a westerly direction to Orchilla, Los Roques, Islas de Aves, Bonaire, Curaçao, and Aruba. This plan has two advantages: (1) it prevents confusion arising from frequent leaps from the mainland coast to offshore islands often belonging to a nation other than the opposite-lying South American state and (2) with the exception of Aruba, which was visited on the eastern lap of the voyage, it follows in a general way the course of the *Velero III*. (Chart 1.)

AN ACCOUNT OF THE COAST LINE

Panama East of Cristobal

From Cristobal the Atlantic coast of Panama trends northeastward 27 miles to Pta. Manzanillo, most northerly point in Panama. Two thirds of the way to Pta. Manzanillo lies Porto Bello, a protected harbor 0.6 mile wide and 1.4 miles deep, one of the best west of Cartagena. Between it and Pta. Manzanillo are Los Farallones and Isla Grande, each of which is marked with a light.

From Pta. Manzanillo to Pta. San Blas, a distance of 34 miles, the coast turns eastward with both San Cristobal and Nombre de Dios bays located in the first 5 miles. At Nombre de Dios Bay a mountain chain arises which forms the backbone of eastern Panama, first as the Cordilleras de San Blas, then, without interruption, as the Serrania del Darien. La Bruja, elevation 3,063 feet, and Cerro Brewster, elevation 3,018 feet, are the highest peaks visible along this stretch, 8 and 14 miles inland, respectively.

Pta. San Blas forms the northeastern limit of the Golfo de San Blas, 6 miles wide along a line drawn south from Pta. San Blas, and indenting west of that line to a similar distance. There are three entrances to the Golfo de San Blas, which is crowded with many small cays, the Canal de San Blas and Canal de Holandes with 11 fathoms, and the Canal de Caobos with 24 fathoms. The 50-fathom line extends well outside the off-lying Cayos de Chichime and Cayos Holandes. Depths to 27 fathoms are to be found within the Gulf itself, and Puerto Mandinga at the western end of the Golfo de San Blas offers anchorage in 10-19 fathoms.

From Pta. San Blas to Isla de Piños, a distance of nearly 80 miles, the coast curves in a southeasterly direction, while offshore to a distance of 9 miles lie the innumerable small islands, cays, and shoals which make up the Archipelago de las Mulatas. These were surveyed in 1915-17 by the *U.S.S. Leonidas,* and a series of detailed charts is available. A number of navigable channels lead to safe anchorages, and fresh water may be found in any of the streams descending from the cordillera. Indian villages are situated on many of the islands, and fish and game are plentiful in the region.

Caledonia Bay

(Expedition Charts 1, 2)
(Collecting Stations A1-A10, A49-A59)

Caledonia Bay is located on the northeast coast of Panama 177 miles east of Cristobal by ship's log and but a short distance from the Colombian border. It extends in a southeasterly direction from Sasardi Point on the northwest to Pta. Escoces on the southeast, a distance of 9 miles, but is indented behind them to 12 miles. From Sasardi Point a series of cays or islands extend 5 miles in the direction of Pta. Escoces, culminating in Isla de Oro, elevation 470 feet. There are two entrances to the bay, the more northerly, between Sasardi Point and Sasardi Islands, leading to Sasardi Harbor, the more southerly, south of Isla de Oro, leading to Caledonia

Harbor. These harbors are separated by a shoal having not more than two fathoms of water. Still farther south, behind Pta. Escoces, lies Port Escoces, site of an attempted colonization by the Scotch in 1699, whence the name, "Caledonia Bay."

Caledonia Bay's most remarkable topographic feature is the narrowness and straightness of the principal channel. A line drawn 320° true through the anchorage in Caledonia Harbor touches neither the mainland nor the fringe of outlying islands, throughout the 12-mile length of the bay, although the distance between these at one point (opposite Mt. Vernon) is only 0.6 mile and is never more than 1.5 miles.

The entrance to Caledonia Harbor is southwest of Isla de Oro and of the outer rock of Isla Piedra, and northwest of the Reventazones Breakers, a series of 3 shoals halfway between Isla de Oro and Pta. Escoces. The channel shoals from 15 fathoms off Outer Rock to 10 fathoms at the anchorage. Vessels of shallow draft may proceed another two miles up the bay in a northwesterly direction, keeping Cyane Island, Chimere Island, and Scorpion Cay on the right, to anchor near the Indian village. At this point the bay shoals to 2 fathoms, then deepens toward Sasardi Harbor, which is best approached from the opposite direction. The entire bay is navigable to the Indian sailing canoes, dozens of which constantly ply the bay in the stiff afternoon breezes.

The mainland shore is covered with dense tropical growth. Coconut palms grow on the beaches and on many of the cays. Indian plantations, located a mile or more inland, are reached by trail or by canoe up one of the several streams which empty into the bay. These streams are responsible for the fine green mud covering the bottom of the bay and for the fact that bottom cannot be seen in depths greater than a fathom or two. The San Blas Indian village is located on one of the three larger islands separating Caledonia Harbor from Sasardi Harbor. These islands would be awash if the water in the bay were to rise another foot or two. Spring rise and fall of tide is only 1.4 feet, neaps 0.4, in contrast to a spring range of 16.2 feet at Balboa, on the Pacific coast of Panama.

There are two annual seasons, wet and dry, the dry season lasting from January to April. At the time of the second visit of the *Velero III* in late April the temperature was almost constant night and day, varying from 78° F. at 2 A.M. to 84° F. at 2 P.M., although a temperature of 90° F. was recorded on an exceptionally hot afternoon. Humidity on this occasion approached saturation, and storm clouds were gathering over the 2,000-foot mountains located little more than two miles to the interior. Light northerly and northwesterly winds were recorded.

A total of twenty-one stations were established in the Caledonia Harbor area (see Chart no. 2), ten on the eastern lap of the voyage and eleven on the western. Of these, one was dredging from the *Velero III* outside Caledonia Bay in 28-29 fathoms, gray mud, at a point 2 miles east of Isla de Oro; five were dredging from the small boat within the bay in depths from 1 to 15 fathoms, mud, shell, and fine sand; four were shore collecting, at San Fulgencio Point, on a reef near Outer Rock, and at the Indian village; two were seine hauls on the mainland beach opposite the anchorage; two were dipping and netting from the skiff and one diving with the helmet on the reef near Outer Rock; two were in brackish and one in fresh water of Rio Aglasenigua; one was dipping at the gangway light; one was handline fishing; and one was a purchase from the Indians. In addition to the above, collections were made of terrestrial plants, insects, birds, mammals, and reptiles, to which no station numbers were assigned, and several hundred items of ethnological interest obtained at the San Blas Indian village.

From Pta. Escoces, which marks the southeastern limit of Caledonia Bay, the coast extends 18 miles in a southeasterly direction to Puerto Obaldia, where the Miel River forms the boundary between Panama and Colombia.

Colombia West of the Magdalena River

(Collecting Stations A11-A15)

Gulf of Darien

The Gulf of Darien is 42 miles long on a line measured due south from Pta. Caribana. Its west coast, from Cape Tiburon southward, proceeds for 33 miles to Pta. de la Revesa in the southeasterly direction determined by the Serrania del Darien, the mountain range encountered 2 miles behind Caledonia Bay. The mountains recede from the coast until they are 23 miles inland opposite Pta. de la Revesa, where the Cerro de Tacarcuna reaches an elevation of 7,500 feet.

Nine miles south of Pta. Revesa lies the delta of the Atrato River, said to be the fourth largest in volume in South America. According to the *Coast Pilot,* "This river resembles the lower Mississippi in grandeur of proportion, with its long reaches, its width, varying from 500 to 800 yards, and its great depth, often exceeding 10 fathoms." Arising in the Antioquian Mountains, it flows northward for several hundred miles. In a survey conducted from a rowboat, no depth less than 28 feet was sounded in 160 miles. Its lower banks are overflowed 10 months of the year and cannot be inhabited. It empties into the Gulf of Darien through

13 mouths, none of which has a depth greater than 6 feet. The dredging of one of these and the partitioning off of the others by means of breakwaters would open to navigation and commerce an untapped source of gold, platinum, ivory nuts, and timber, to say nothing of agricultural possibilities. Silt and floating debris carried down the Atrato River are largely responsible for the extreme muddiness of the Gulf of Darien and the large quantities of driftwood encountered, although other smaller rivers contribute to a lesser degree.

Shoal water is reported to extend about 20 miles off Pta. de Caribana, a warning sufficient to keep all large vessels out of the Gulf of Darien. However, depths of 32 fathoms are shown in the upper gulf, and 13 fathoms in Columbia Bay, a pocket south of the Atrato delta charted by the Darien Expedition of 1871. The entire region is regarded as unhealthful, this being the principal reason for its retarded development.

From Pta. de Caribana, the Colombian coast line trends in a general northeasterly direction for almost 300 miles to Cape Augusta at the mouth of the Magdalena River. Since the course of the *Velero III* was 45 miles offshore for much of this distance, it will be covered very briefly here. One large and important indentation of the coast, the Gulf of Morosquillo, occurs some 68 miles northeast of Pta. Caribana. It is 18 miles wide between Pta. Mestizos and Pta. San Bernardo and 8 and 9 miles deep, and offers protected anchorage. The Rio Sinu empties into the gulf in a position corresponding to that of the Rio Atrato in the Gulf of Darien, its delta enclosing Puerto Cispata in place of Columbia Bay. However, the Rio Sinu, unlike the Atrato, is navigable for but 95 miles and to vessels of 3½-foot draft only.

West of Pta. San Bernardo are the Isletas de San Bernardo, consisting of eleven large cays and several smaller ones scattered over an area about 130 square miles. The islets are wooded, surrounded by shallow banks, and separated from the mainland by a tortuous channel.

Twenty-six miles north of Pta. San Bernardo lies Pta. Baru, southwest extremity of Isla de Baru, which forms at once the west side of the Bay of Barbacoas and the south side of Cartagena Harbor. The Islas de Rosario—a group of four small cays known as Islas Rosario, Arena, Grande, and Tesoro—are located a few miles west of Pta. Baru. Remarks made for the Islas de San Bernardo apply equally well here; indeed, the two groups are often mistaken for one another.

The Bay of Barbacoas is the outlet of a remarkable natural canal "El Dique," which enters the Magdalena River at Calamar. This canal is navigable to river steamers except in the dry season. The Bay of Barbacoas communicates with Cartagena Bay to the north by means of the Caballos Canal.

Cartagena

Cartagena Harbor opens to the sea 12 miles north of Pta. Baru via the Boca Chica, a channel only ⅓ mile wide but recently dredged to 40 feet. The forts of San Jose and San Fernando flank the entrance on the south and north sides, respectively. The bay itself is 9 miles long with a greatest width of 4 miles. Its western side is formed by Isla Tierra Bomba, elevation 273 feet. North of the island is Boca Grande, over a mile wide but no longer navigable to any except small boats because of natural filling and a rock barrier wall. Northeast of Boca Grande is a small bay forming an inner harbor. Depths in the bay are 15-16 fathoms, with 10 fathoms within the inner harbor. Anchorage with protection from all winds may be had in any part of the bay.

The city of Cartagena is located on the north shore of the bay due west of Colina de la Popa, a 511-foot hill. It is a compact settlement, composed largely of ruins, and is enclosed by heavy walls of stone masonry. The present population is about 73,190. The city is connected by rail and canal with the Magdalena River at Calamar and is a regular port of call for steamers plying between New York or New Orleans and Cristobal. An oil-loading terminal is situated at Mamonal on the east side of the bay. The United States is represented by a vice-consul and the Colombian government by customs, quarantine, and immigration authorities. Cartagena seems to offer many advantages over Barranquilla, a river port, particularly in the servicing of ocean-going vessels.

From Cartagena to Cape Augusta, a distance of 58 miles, but one significant landmark occurs. It is Pta. Galera, 30 miles southwest of Cape Augusta, useful to vessels coming from the west in making a landfall preliminary to ascending the Magdalena River. A single dredge haul was made from the *Velero III* 5 miles northwest of Pta. Galera light in 12 fathoms, sand. (See Chart no. 1, A48.)

Puerto Colombia

Puerto Colombia is formed by the mainland of Colombia on the south and east, and by a shoal to the north which developed first into two islands and recently into a peninsula. The islands were Isla Verde and Isla Sabanilla; the peninsula which now joins them to each other and to the mainland is called the Peninsula de Sabanilla; and the bay which it encloses, the Bahia de Sabanilla. The bay is 3 miles wide between Pta. Hermosa on the south and Pta. Velilla on the north, and 3 miles deep between Pta. Velilla and Pta. Nisperal on the mainland. Two shoals, Banco Culebra and Banco Arena, limit the anchorage in the north part

of the bay. The entire bay lies within the 10-fathom curve, with anchorage in 5-10 fathoms, green mud, over most of its area. The *Velero III* anchored just inside the 5-fathom curve, ⅜ mile off the end of the wharf and a mile offshore.

A railroad and highway connect Puerto Colombia with Barranquilla, about 10 miles distant. Perhaps the greater part of the trade of the inland city passes through this port, which maintains steamship connections with Cristobal, New Orleans, New York, and Europe.

No collecting was attempted by the *Velero III* in the vicinity of Puerto Colombia, the stop serving merely to take on a pilot for the ascent of the Magdalena River, as required by law.

Magdalena River

The entrance to the Magdalena River, called Boca de Ceniza, is located about 3 miles east of Cabo Augusta and is ½ mile wide. A depth of 33 feet (5½ fathoms) at the entrance is shown on the chart, but the bottom is constantly shifting, on account of the changing force of the river and the amount of accumulated debris carried down. The speed of the current, normally 2 knots, may approach 6 during flood season, May to October. The muddy waters of the Magdalena discolor the sea for distances up to 60 miles offshore. Where the brown water meets the green of the Caribbean a millrace occurs, which is dangerous to small boats and uncomfortable to passengers in larger vessels. Pilotage is compulsory, the pilot coming aboard at Puerto Colombia. East and west breakwaters extend ½ mile out into the sea at the river's mouth. The east breakwater ends at Pta. Faro, but the west breakwater extends a good 4 miles up the river past the cienagas de Cantagallo and Mallorquin. Las Flores, 5 miles up the river and opposite Isla Nueva, is the terminus of a railroad from Puerto Colombia and the point at which customs and quarantine officials board incoming vessels.

The city of Barranquilla is located on the Magdalena River about 7 miles from its mouth. It has a population of 147,000 and is the principal port of Colombia, serving the entire Magdalena River basin. The Magdalena is navigable 587 miles to Girardot, whence a railroad may be taken to Bogota, the capital. The trip made in river steamers requires a week or more, although 3 or 4 days suffice for the return. By plane the time is cut to 2½ hours. The principal crop of Colombia is a mild coffee, greatly prized in world markets. New and modern docking facilities are located opposite the city of Barranquilla and are connected with it by a road leading across a swamp.

A single collecting station was located in the vicinity of Barranquilla, at the point at which the road from the wharf crosses the swamp mentioned above.

Colombia East of the Magdalena River

From Cabo Augusta to Morro Grande, a distance of 38 miles in an east-northeasterly direction, the coast indents some 13 miles to Boca de la Cienaga, outlet of Cienaga Grande de Santa Maria, a large body of water belonging to the Magdalena delta system.

Morro Grande, a 200-foot islet topped by a lighthouse, is situated on the west side of Santa Marta Bay, one of the best anchorages on the north Colombian coast. A peninsula shaped like an inverted fishhook forms the north and west shores of the bay and makes an inner harbor opposite the city of Santa Marta. Depths in the outer bay are from 13 to 30 fathoms, with anchorage in 16 fathoms at the entrance to the inner harbor opposite Pta. Taganguilla, the "barb" of the hook. A railroad extends from banana plantations in the interior to the wharves at which United Fruit boats make regular calls. The lights of the city were clearly visible as the *Velero III* passed 11 miles offshore.

From Morro Grande to Cabo la Vela, a distance of 135 miles to the east northeast, the coast again recedes, but less gradually. The 5-fathom curve extends 10 miles from the coast north of Laguna Grande. The area immediately behind the shore line is low and barren, but the western portion of the stretch is dominated by the Sierra Nevada de Santa Marta, a snow-capped mountain range with an extreme elevation of 19,000 feet. This magnificent range was clearly visible from the deck of the *Velero III,* although nearly 50 miles away.

Cabo la Vela juts westward from the Peninsula de Guajira a distance of 2 miles, giving slight protection from the prevailing northeasterly winds, which reach gale proportions in this vicinity. It consists of a series of low hills, one of which rises to an elevation of 265 feet. A more prominent landmark is Pilon de Azucar (sugar loaf), of no greater height but having an isolated position to the northeast. The bottom southwest of Cabo la Vela shoals so gradually that vessels can scarcely approach close enough to take such shelter as the cape affords. The *Velero III* found anchorage 11 miles south southwest of the light in only 5 fathoms. (See Chart no. 3.)

Two stations were made in the vicinity of the anchorage, a surface station at the gangway light and sargassum obtained from the anchor chain. Two dredging stations were made closer in, one 2 miles southwest

of the cape, 21-22 fathoms, and another 1 mile southwest in 10-13 fathoms. Only the hours from 6 to 9 A.M. could be utilized for dredging because of the intensity of the north-northeast wind, which reached a force of 5 on the Beaufort Scale by 10 A.M. and 6 by 12 noon.

From Cabo la Vela to Pta. de Gallinas, a distance of 32 miles in the same east-northeasterly direction, are two large bays with narrow entrances. El Portete, located 12 miles east of Cape la Vela, has a shallow entrance between Pta. Gran Tonel and Pta. Coco. Eleven miles east of Pta. Coco is Pta. Cañon, marking the deeper entrance of Bahia Honda.

Bahia Honda, Colombia, is located on the northwest side of the Peninsula de Guajira about 8 miles southwest of Pta. de Gallinas. It is a deeply indented bay nearly 3 miles deep opposite its opening between Pta. Cañon and Pta. Soldado with a width of 6 miles in a northeasterly-southwesterly direction behind them. Pta. Cañon on the west is 121 feet high, and Pta. Soldado on the east is from 80 to 93 feet high. Both points are rocky, and a long mesa on which a customs house is located extends eastward from Pta. Soldado. Anchorage may be had within the bay in 6½ fathoms, sand bottom.

Two dredge hauls were made from the *Velero III* in the vicinity of Bahia Honda, about 2¼ miles and 1½ miles offshore and in 9-10 fathoms, coralline bottom. Not wishing to enter the port, the *Velero III* kept well outside the bay itself, anchoring off the concrete building on Pta. Soldado, which houses a garrison of soldiers. The general aspect of the hinterland is one of extreme barrenness. (See Chart no. 4.)

Venezuela West of La Guaira

Gulf of Venezuela

Between Pta. de Gallinas, the northernmost point of the Peninsula de Guajira, and Cabo San Roman, northernmost point on the Peninsula de Paraguana, an airline distance of 99 miles, occurs the most extensive indentation on the north coast of South America, leading to the Gulf of Venezuela. The gulf is 53 miles wide at its entrance between Pta. de Espada on the west and Pta. la Macolla on the east, and it opens to an extreme width of 104 miles opposite Bahia de Calabozo, its western portion. Average depths are 20-23 fathoms in the eastern portion of the Gulf, 12-15 fathoms in the Bahia de Calabozo, with green mud bottom. In the southwest portion of the Gulf of Venezuela is the entrance to Laguna de Maracaibo, a large lake measuring 60 by 100 miles and with depths to 80 fathoms. On the 33-mile-long narrows separating the Gulf

from the lake proper is situated Maracaibo, second largest city in Venezuela, with a population of 85,000. Vessels ply regularly between Maracaibo and both Aruba and Curaçao, transporting crude petroleum to the refineries.

Wind with a force of from 5 to 7, Beaufort Scale, is regularly encountered in the Gulf of Venezuela region from December to March, as at Cape la Vela. The entire region is arid and devoid of vegetation. It is considered healthful except in summer months.

From Cape San Roman the coast line turns southeastward for 19 miles to Pta. de Aricula, then due south another 15 miles to the constriction formed by the Golfete de Coro, an eastern extension of the Gulf of Venezuela, then southwest again for 18 miles along a narrow isthmus connecting the Peninsula de Paraguana to the South American mainland at Vela de Coro. For this entire distance of 52 miles the only prominence offering aid to navigation is the Pan de Santa Ana, elevation 2,800 feet, located in the south central portion of the peninsula and visible on clear days for 60 miles.

From Vela de Coro the coast line resumes its eastward trend for 42 miles to Pta. Zamuro, then turns southeastward 50 miles to Pta. Tucacas. This combined stretch of 92 miles finds the coast increasingly hilly, with numerous isolated peaks at greater or lesser distances inland. Among these may be mentioned Cerro de la Teta, elevation 4,110 feet and located 20 miles southwest of Vela de Coro, Colina del Capadare, elevation 1,620 feet and located 10 miles west of Pta. San Juan, and Mt. Mission, elevation 2,358 feet and situated 14 miles west of Tucacas on the Golfo Triste.

The Golfo Triste is 26 miles wide between Pta. Tucacas on the northwest and Puerto Cabello on the southeast, and indents to a depth of 10 miles. The town of Tucacas, with a railroad connection to Barquismeto and the Aroa copper mines, is on a shallow lagoon about a mile long, formed by Pta. Brava, a southerly extension of Pta. Tucacas, and the mainland. Clearance must be had at Puerto Cabello.

Puerto Cabello

The city of Puerto Cabello is situated on a peninsula on the southeastern shore of the Golfo Triste. It has a population of 27,000 and is a secondary port for Caracas, from which it may be reached by railroad. The immediate inland city served by Puerto Cabello is Valencia, capital

of the state of Carabobo and situated on the western shore of Lake Valencia, 18 miles from the sea. There are a 1,450-foot wharf at Puerto Cabello and customs and shipping offices. Grace liners discharge passengers at La Guaira and pick them up a day later at Puerto Cabello, allowing them to visit Maracai and Lake Valencia by rail. Because of swamps in the vicinity, Puerto Cabello is considered not so healthful as La Guaira.

From Puerto Cabello to La Guaira, a distance of 64 miles, the coast trends due east with few irregularities. A mountain chain which has been 16 miles or more from the coast with elevations of 3,200 feet swings north at Puerto Cabello to within 8 miles of the coast and increases in height in an easterly direction until it culminates off Chichiriviche Point in Palamar and Lagunita peaks, 7,438 and 7,874 feet, respectively. High mountains, covered with green tropical and semitropical foliage and rising abruptly from the sea, afford scenery of first rank. Not less than 25 watercourses, all of them short, empty into the sea in this 64-mile distance. At Port Turiamo, 10 miles east of Puerto Cabello, there is a small bay giving excellent anchorage in 20 fathoms.

La Guaira

The port of La Guaira, Venezuela, is situated on a strip of level land a few hundred yards wide at the foot of massive mountains, of which Mt. Avila, elevation 7,070, and Mt. Naiguita, elevation 9,072, are the highest. The harbor itself is entirely artificial, consisting of a breakwater behind which anchorage may be had in depths to 5½ fathoms with reasonable security from the swells which make the open roadstead beyond exceedingly dangerous, particularly in the winter months. The bottom is fine sand, or sand and shell, with coarser sand and occasional rocks in the western portion of the bay.

The prevailing current outside the breakwater is westerly, ½ knot, as the equatorial current parallels the Venezuelan coast a short distance offshore. At certain seasons, particularly in the autumn, a countercurrent with a 2½-knot speed occurs. Conspicuous landmarks visible from the sea are oil tanks and radio tower west of the city and a fort (La Vigia or Citadel) directly behind the city at an elevation of 359 feet. The port is served by a railroad which connects with Caracas, the capital, 23 miles inland by rail, and which extends to the end of the 680-yard breakwater with spurs to warehouses at the dockside.

No collecting was accomplished because of the heavy swell.

Caracas

Caracas, the capital, is a city of 216,418 inhabitants located behind the coastal range at an altitude of 3,500 feet. It may be reached by road or railroad, the distance in either case being several times the airline distance of 9 miles. The climate is much more moderate than that of La Guaira and the city considerably more healthful. Caracas possesses all the cultural adjuncts of a capital city—university, museum, observatory, cathedrals, and government buildings. From Caracas railroads lead to Puerto Cabello to the west and Santa Theresa and Guarenas to the east. There is an auto road to the shores of Lake Valencia, where the only collecting station in the locality was established.

Venezuela East of La Guaira

East of La Guaira the coast continues in an easterly direction for 40 miles to Maspa Point. The mountain range which parallels the coast becomes higher at Mt. Naiguita, elevation 9,072 feet, after which the main ridge may no longer be seen from the sea because of foothills. Mt. Caculo, elevation 7,430 feet, is visible 8 miles inland from Chuspa Bay, which lies just west of Maspa Point.

Centinela Island, elevation 70 feet, lies 15 miles northeast of Maspa Point.

From Maspa Point to Cape Codera, a distance of 13 miles, the coast dips slightly to the south of east while preserving the same general character. Between Cape Codera and Morro de Barcelona, however, it recedes more definitely in a broad arc for a distance of 81 miles and all traces of hills vanish. The only conspicuous landmark in this distance is Morro de Piritu, elevation 1,568 feet, lying 8 miles east of Unare Point, which itself is located on an island in a lagoon at the mouth of the Unare River. The 5-fathom curve extends 3 miles off Unare Point, and the 100-fathom mark is 24 miles offshore, or halfway to Tortuga Island. With the exception of Tortuga Island, 48 miles north of Unare Point, the only offshore obstruction in this distance is the Piritu Islands, lying 5 miles off the coast and 15 miles west of Barcelona Bay.

Tortuga Island

(Chart 6, Collecting Stations A20-A23, A43-A44)

The island of Tortuga lies about 45 miles northeast of Cape Codera on the coast of Venezuela. It is a small island, 12 miles east and west by 5 miles north and south, and gives the impression of being even smaller

because of its extreme lowness, particularly at the western end. At no point does it rise above 100 feet in elevation. The south shore, between Arenas Point at the western end of the island and Oriental Point at the eastern, is almost straight and has but one named locality, El Carnero, a shallow sound enclosed by several low islets. The east shore, between Oriental and Delgada points, is free from outlying barriers. The north, and particularly northwest, shore has several off-lying cays or islets: Anguila Cay, Herradura Cay, and Los Tortuguillos, from east to west, respectively. The only anchorage is between Los Tortuguillos, two islets northwest of the main island, and Arenas Point at its western end. The *Velero III* anchored just south of the larger of the Tortuguillos in about 10 fathoms.

Dredging was accomplished from the *Velero III* 7 miles north of Tortuga Island in 40-41 fathoms, sand and shell, and 4 miles north of the island in 21-22 fathoms, dead coral bottom. A shore collecting station was established on the main island opposite Los Tortuguillos, a seine haul at the same place, a dipping station at the gangway light while at anchor, and a small boat dredge station in 2-5 fathoms, which took in much of the shallows between ship and shore and around Arenas Point to within sight of the small village on its south side. (See Chart no. 6.)

The prevailing current off Tortuga Island is in a westerly direction with a maximum speed of ¾ knot. The daytime temperature at the time of the visit of the *Velero III* in April hovered around 76° F.

Between the Morro de Barcelona, which forms the northern extremity of Barcelona Bay, and Port Mochima, a distance of 26 miles in an east-northeasterly direction, the coast is exceedingly irregular and has many off-lying islands. From west to east the bays of importance are Guanta Harbor, the Gulf of Santa Fe, Tigrillo Bay, and Port Mochima. The islands are Borracha, the Chimanas (Oeste, Grande, and Segunda), Monos, Picuda Grande, and the Caracas (Oeste, Este, and Venados). Since these localities were not visited by the *Velero III,* they will not be described except for mention of the fact that the town of Guanta, located on Guanta Harbor, communicates with Barcelona and the interior by rail.

From Port Mochima to Carenero Point the coast trends due east, then northeast to the city of Cumana, a distance of 10 miles. Cumana is an open roadstead, but is sheltered from the northeast trade winds by its

favorable location at the mouth of the Gulf of Cariaco. Capital and port of entry for the state of Sucre, it is a city of 20,000 people, or ten times the population of Guanta. Coastwise vessels call regularly, and steamers connect it with New York. Anchorage may be had in 16 fathoms, rock bottom.

The Gulf of Cariaco indents due east of Carenero Point for 30 miles to the mouth of the Cariaco River. It is 9 miles wide opposite Laguna Grande del Obispo but only 3 miles wide at its mouth, between Carenero Point and Arenas Point, with 42 fathoms in the center, and anchorage only at its extreme east end. There are no towns or bays of importance.

From Arenas Point to Araya Bank the coast for 11 miles trends in a northwesterly direction. Araya Bank lies 2½ miles off Araya Point, western tip of the Peninsula de Araya, which separates the Gulf of Cariaco from the open sea to the north. From Araya Bank to Morro de Chacopata, also separated from the mainland by shoal water, the coast turns due east again for 30 miles to form the north shore of the peninsula, which narrows to less than 2 miles opposite Salinas Bight. The south shore of Margarita Island parallels this coast at an average distance of 13 miles offshore, with Cubagua and Coche islands located in the intervening channel at distances of 9 and 6½ miles offshore, respectively.

Margarita Island

(Chart 7, Collecting Station A42)

The island of Margarita, Venezuela, lies from 12 to 15 miles off the mainland coast opposite the narrow peninsula which forms the northern boundary of the Gulf of Cariaco. It is the largest of the Venezuelan islands, having a length of 30 miles and an extreme breadth of 17. The latter figure is misleading, however, for Margarita is only 3 miles wide at its narrowest point, with most of this width occupied by Laguna Grande, an arm of the sea which almost separates Margarita Island into two portions. Of these the eastern is the larger, having the highest mountain, Cerros de la Vega, elevation 3,240 feet, at its center. It also is the center of habitation, being the site of Asuncion, capital of the island, and of Porlamar and Pampatar, two coastal villages. The western portion of the island is massive rock culminating in Cerros de Macanao, elevation 2,304 feet, and lacks the cultivated valleys of the east end. The north and south indentations opposite Laguna Grande are known as North Bay and Mangles Bay, respectively; but, although the largest bays, they are not the most frequented. Vessels call more frequently at La Mar Bay, where anchorage may be had in 4½ fathoms and at Pampatar Bay, where

anchorage may be had in 7 to 8 fathoms. These bays are located off the towns of Porlamar and Pampatar, respectively, on the southeast shore of the island. The latter anchorage is frequented by coastwise traders and is a regular port of call for ocean-going vessels, with a customs house and pier. No recent figures are available on the population of Margarita Island, but it approached 50,000 in the days of natural pearl fisheries.

The aspect of Margarita Island is quite different from that of Curaçao and Aruba, the only two off-coast islands approaching it in size. There are probably two good reasons for this difference. One is that, being so much higher than the Dutch islands, Margarita receives condensed moisture from the higher atmospheric layers. The other is that the desert aspect of the mainland coast in western Venezuela has by this time become more tropical. The result is that Margarita Island, particularly the eastern portion, is well vegetated. This was apparent even at the end of the dry season. The similarity to the dry, but well-covered hillsides of Parker Bay, on the Pacific coast of Costa Rica, from which members of the *Velero* party had recently come, was striking.

The *Velero III* did not put in to port at Margarita Island, but several dredging stations were occupied near by in passing. These were midway in the channel between Mosquitos Point and Coche Island, 19-33 fathoms, coarse sand and shell, accomplished on the eastern lap of the cruise, and 7 miles north of the west end of the island, 21-22 fathoms, sand and shell, and 4 miles north, 17-18 fathoms, sand and shell, accomplished on the return voyage. (See Chart no. 7.)

Los Frayles are a group of rocks lying 10 miles east by north of Cabo de la Isla, most northerly point of Margarita Island. The largest is about 300 feet high and steep sided, with no sandy beach visible.

Cubagua and Coche Islands

(Collecting Stations A24-A33)

In the channel between Margarita Island and the Venezuelan mainland lie two small islands so similar in many respects that they are treated together. The westernmost is Cubagua and the easternmost Coche Island. The distance between them is 9½ miles, which is a little more than the distance of Cubagua from the mainland and about twice the distance of either from Margarita Island. The length of Cubagua Island is 5 miles, that of Coche 6. The height of each is approximately 200 feet. Both are steep sided, with conspicuous light bluffs, and from each a shoal extends toward the most southerly projecting point of Margarita Island. Depths of 24 and 25 fathoms may be found, however, between them and the larger island.

Two shore collecting stations were made on the west end of Cubagua Island in coral rock, three dredging stations with the small boat in the same vicinity with algae, mud, and coarse black sand reported, and a dipping station beneath the gangway light at the anchorage. From the *Velero III* dredge hauls were made 1½ miles southeast of Cubagua Island in 13 fathoms, sand, mud; and three hauls 3 miles northeast of Coche Island, in the channel between it and Margarita Island, in 19-33 fathoms, sand and shell. (See Chart no. 7.)

The mainland coast continues easterly from Morro de Chacopata to Cabo Tres Puntas, a distance of 65 miles, with many slight irregularities, off-lying rocks, and shoals. The coast line again becomes like that near La Guaira, the mountains in the distance approaching the shore line and increasing in height from west to east. Mt. Redondo, elevation 1,315 feet, lies 13 miles south of Morro de la Esmeralda; Mt. San Jose, elevation 3,380 feet, lies 10 miles south of Morro Blanco; and Mt. Punto Santo, elevation 3,470 feet, is situated but 6 miles southeast of Carupano. Carupano, population 15,000, is the largest port along this stretch of the coast and is regularly visited by coastal and intercontinental steamers.

The Testigos Islands are located 40 miles off this coast, due north from Cape Malapascua. Midway in the channel between lie Cumberland Banks, which shoal to 5 fathoms, and Green Bank, with 4½ to 6 fathoms reported. Otherwise, the coast is free from obstructions.

From Cabo Tres Puntas to Penas Point, a distance of 51 miles, the eastward-trending coast also forms the northern shore of the Peninsula of Paria, which encloses the Gulf of Paria to the north. The shore is bold, steep, and wooded, and has no indentations other than those formed by the spurs of the high mountain ranges. The most lofty peaks are located southeast of Cabo Tres Puntas and reach elevations of 4,115 feet. Two other peaks, with elevations of 3,501 and 3,232 feet, occur 14 and 7 miles west of Penas Point, respectively. It is this mountain range, interrupted for 10 miles by Bocas del Dragon, the northern entrance to the Gulf of Paria, which continues eastward to form the north shore of the island of Trinidad.

British West Indies

(Chart 8, Collecting Stations A34-A41)

Trinidad

The island of Trinidad is the southern anchor to the chain of islands known as the West Indies. It is roughly rectangular in shape, 43 miles

long and 27 miles wide at its midpoint, with daggerlike peninsulas extending from its northwest and southwest corners in the direction of the South American mainland. These, together with the east coast of Venezuela, enclose the Gulf of Paria, a shallow body of water affording safe anchorage in 12-20 fathoms throughout its length and breadth. A mountain chain, culminating in El Cerro de Aripo, elevation 3,085 feet, and El Tucuch, elevation 3,072 feet, extends along the north side of the island and represents a continuation of the range forming the north coast of Venezuela, the islands of Chacachacare, Huevos, and Monos standing as steppingstones between. South of this mountain chain, which sends lateral spurs as far south as a line drawn due east of Port of Spain, the island is low and in places swampy with the exception of isolated Mt. Tamana, rising to 1,009 feet in the central eastern portion, and the Trinity hills, attaining 997 feet along the southeastern coast. The only prominence of any size visible from the Gulf of Paria south of Port of Spain is a 582-foot hill marking the village of San Fernando, on the road to the Pitch Lake.

The island of Trinidad has a population of 484,900 inhabitants of many races: Venezuelan, Negro, East Indian, and, of course, British. Agriculture and petroleum products are the sustaining industries. Cacao has recently outstripped sugar cane as the principal crop, one sixth of the island area being devoted to its culture. Sugar cane and coconuts are important secondary crops. The Pitch Lake in the southwestern portion of the island is the world's greatest source of asphalt, the oil fields which feed it being in 1928 the largest, single producing unit in the British Empire with a production of 7,600,000 barrels. Oil and asphalt are loaded at wharves with pipe lines extending ½ mile into the Gulf of Paria at San Fernando Anchorage.

Port of Spain

Port of Spain, the principal city of Trinidad, is located in the northwest portion of the island, fronting on the Gulf of Paria south of the St. Anne Mountains and west of a lateral spur known as the La Ventille hills. It is a modern city of 75,000, the terminus of a railroad from Arima and San Fernando, and shows British influence in its planning, its architecture, and its institutions. The Government House, Royal College, Queen's Park Botanical Garden, and Queen's Park Hotel front on Queen's Park Savannah, an extensive recreational area north of the business portion of the city. The colonial hospital, many churches, and an institute for the blind are evidences of social and charitable activity.

Landmarks conspicuous from the bay are the La Ventille church, located on La Ventille Hill at an elevation of 535 feet, and Fort St. George signal station, elevation 1,069 feet, on a hillside northwest of the city. The Maraval and St. Anne rivers flow through the city and empty west and east of St. Vincent's Jetty, respectively.

St. Vincent's Jetty extends 375 feet into the bay at the foot of Queen's Wharf, on which are located customs and harbormaster's offices. The bay is so shallow that vessels must anchor one mile off to be beyond the 3-fathom curve, another mile to be clear of 5 fathoms. Dredging of a basin 32 feet deep west-northwest of St. Vincent's Wharf with a 30-foot-deep approach from the west-southwest was in progress at the time of the visit of the *Velero III* in April, 1939. The bottom is soft mud, because of the drainage of the Caroni swamps to the east, and vessels must allow sufficient clearance to avoid fouling intakes. Mean tidal range is 3.4 feet, spring 4.0 feet.

Port of Spain is linked with Europe and North and South America by steamship lines and cables. Air-mail service to Miami is regular and has no doubt increased over the 4-times-weekly service in effect in 1939. The climate is healthful and sanitary conditions are good. Temperatures ranged from 76° F. at 2 A.M. to 82° F. at 2 P.M. while the *Velero III* was anchored in the bay.

Dredging was accomplished from the small boat near the five islands (Las Cotorras), dipping at the gangway light, and shore collecting at Manzanilla, on the opposite side of the island. Fish were purchased at the public market. (See Charts nos. 1, 8.)

Tobago Island

(Chart 9)

The island of Tobago, one of the British West Indies, lies off the northeast corner of Trinidad in such a position as to be caught in the full force of the equatorial current, which sweeps up the east coast of South America and enters the Caribbean through every opening between the Lesser Antilles. It is a heavily wooded island, 23 miles in length and 6 miles in greatest breadth, trending in a northeasterly direction, and having a mountain chain with elevations to 1,910 feet extending along its eastern two thirds. The higher peaks are near the northern shore, which is consequently steep and little indented, save at Man-o'-War and Great Courland bays. The southern slope is more gradual, several side spurs extending out to rocky points and enclosing between them well-drained valleys met by indentations of the shore line at such bays as Rockly, Hillsborough, Prince, King, and Tyrrel. Little Tobago Island lies off Tyrrel Bay at the eastern end of Tobago Island, and the Giles or Melville

Islands lie off the northeast end. These smaller islands are separated from the main island by deep channels, but currents approaching 3 knots make them unsafe for navigation.

The population of the island is about 25,000 inhabitants. The principal occupation is agriculture, the fertile valleys of Tobago being ideally suited to the cultivation of coconut, banana, and cacao.

Scarborough

The principal port of Tobago is the town of Scarborough, located on Rockly Bay, which extends 3½ miles from Bacolet Point to an unnamed point ½ mile east of Columbus Point. The bay is open to the southwest and never free from a bad swell. Anchorage was had in 20 fathoms off Fort George. However, smaller vessels can anchor farther up the bay opposite Scarborough. A depth of only 4 feet of water at the end of the 75-foot wharf makes it necessary for the combination freight and passenger steamer which makes triweekly trips from Port of Spain to lighter all cargo ashore. The town of Scarborough is located on the hillside to the right and is well concealed by trees until closely approached.

The air temperatures at the anchorage rose from 76° F. at 2 A.M. to 86° F. at 2 P.M. during the short stay of the *Velero III*.

Dredging was accomplished from the small dredge boat in Rockly Bay, 9-18 fathoms, mud, and a seine haul was made on the beach just west of Scarborough. (See Chart no. 9)

Four miles due west of Scarborough, but on the opposite side of the island, lies Buccoo Bay. It is the most westerly of a series of four bays, Great Courland, Stone Haven, Little Courland, and Buccoo, which are identical except in one respect: Buccoo Bay is the only one closed by a reef. Buccoo Reef extends from 1¼ miles north of Pigeon Point to Wolf Rock, on the opposite side of the bay, except for a narrow entrance usable only by those with local knowledge and in the smallest of sailing vessels. The reef is less than a fathom beneath the surface, uncovers at low tide, and has a clearly defined outer edge.

A shore collecting station was made on the outer portion of Buccoo Reef, and a seine was hauled on the sandy beach of Buccoo Bay. (See Chart no. 9.)

Islands off the Coast of Venezuela

The following five islands or island groups lay north of the course of the *Velero III* and were not visited on the 1939 Expedition. A paragraph is devoted to the description of each because they fall within the general area covered by this account and because they offer an attractive field for future investigation.

Los Hermanos

Forty-six miles northwest of Cabo de la Isla, Margarita Island, lies Isla del Pico, elevation 570 feet, largest of a group of three islets forming the southern half of an archipelago known as Los Hermanos. Four miles northwest of Isla del Pico lies Orquilla Island, elevation 650 feet, largest of the northern group of four islands. Composed of granite boulders, with cactus and grass as vegetation, Orquilla Island is said to be the home of the gannet, boatswain, and other sea birds.

Blanquilla Island

Nine miles west of Orquilla Island lies Blanquilla Island, a low, rolling island 6½ miles long and 3½ miles wide. It is also composed of granite, overlaid with coral, and supports a meager growth of grass, cactus, and a few clumps of trees. Anchorage may be found in 18 fathoms, sand, a mile from the northwest end of the island and opposite its only habitation.

Orchilla Island

Orchilla Island lies 84 miles west of Blanquilla Island and 59 miles due north of Centinela Island on the mainland. It is nearly 8 miles long, east and west, but only a mile wide. Low and flat at its eastern end, it rises toward Mt. Walker, elevation 400 feet, near its western end. Farallon Rock lies off its abrupt west end and a number of cays off its northeast shore. Orchilla Harbor is formed between Northeast and Storm cays, which enclose it like parentheses. Although the lighted channel at the north is but 400 yards wide and the maximum depth of the anchorage is 24 feet, the harbor gives excellent protection to small vessels. A safe anchorage for larger vessels is located off a group of houses at the southwest end of the island in 7 fathoms, sand. There is a prevailing westerly current of 1½ knots past the island.

Los Roques

Twenty-two miles west of Orchilla Island lies Grande Cay, largest of an extensive group of cays known as Los Roques. It is low, flat, triangular in shape, and surrounded by shoals, and measures approximately 6 by 7 miles. The remainder of the cays are much smaller and are scattered over an area 23 miles from east to west and 13 miles from north to south. The best anchorage is Port El Roque, formed by many cays at the northeast extremity of the group, and marked by a light. After entering

one of a number of navigable channels, the widest of which is Northeast Channel, with a width of 600 yards, anchorage may be had in 12-14 fathoms opposite a fishing village. Currents are variable in direction and force, sometimes reaching a speed of 3 knots.

Islas de Aves

Forty-four miles west of Port El Roque lies Ave de Barlovento, easternmost of another small group of cays formed upon an underlying coral reef. Thirteen miles westward again is Ave de Sotavento, nucleus of a similar small group. Fish and turtles are said to abound in the lagoons and shallows, accounting for the abundance of sea birds from which the islands received their name.

Thirty-two miles west of Ave de Sotavento lies the island of Bonaire, easternmost of the Netherlands West Indies.

Netherlands West Indies

(Collecting Stations A16, A18)

The Netherlands West Indies consist of three larger islands located from 15 to 50 miles off the north coast of South America opposite Venezuela. These islands are known as Bonaire, Curaçao, and Aruba. All three have their long axes trending in a northwesterly direction, all three are arid and devoid of much vegetation, and all three are considerably longer than wide. The distance between Bonaire and Curaçao is 27 miles, while that between Curaçao and Aruba is 43. Bonaire and Curaçao are separated from the mainland by depths of 900 and 700 fathoms, respectively, but the depth of the channel between Aruba and the Peninsula of Paraguana is little more than 100 fathoms. Bonaire has a satellite islet, Little Bonaire, off Kralendijk on its western side, and Little Curaçao stands 8 miles off the southwest point of Curaçao.

Bonaire

The island of Bonaire is 19 miles long and has a maximum width of 6 miles. The northern portion is hilly, with Brandaris Peak, elevation 768 feet, its greatest elevation. The southern portion is low, sandy wasteland. Vegetation is sparse; trees grow in clumps which are visible from shipboard.

The town of Kralendijk, population 5,700, is situated on the only anchorage, Kralendijk Road, located on the west side of the island at its

midpoint, and inside Little Bonaire Island. Both northwest and southwest channels are navigable. Anchorage is on a narrow bank within 300 yards of shore, and vessels are advised to make fast to shore with a hawser and haul themselves into position.

Curaçao

(Collecting Stations A45-A47)

The island of Curaçao is the largest and most important of the three. It is 33 miles long and 6 miles wide and has one peak, Mt. St. Christoffel, which reaches an elevation of 1,220 feet. This peak is located at the extreme northwest portion of the island in a position similar to that occupied by Brandaris Peak on Bonaire. A secondary elevation, Mt. Santa Barbara, elevation 633 feet, is located at the southeast end, and much of the intervening portion of the island is hilly. The population of the island is about 50,000 inhabitants, more than half of whom live in the principal city, Willemstad.

A current setting to westward occurs seasonally along the southwest shore of the island, and care must be taken in approaching the narrow entrance to Santa Anna Bay.

Willemstad

(Chart 10)

The principal port of the Netherlands West Indies is located at Willemstad, the capital city, on the south side of the island of Curaçao. The harbor entrance is a narrow channel known as Santa Anna Bay, which divides the city into two parts. Santa Anna Bay is but 120-200 yards wide with depths to 12 fathoms, and is spanned by a unique pontoon bridge which connects Willemstad proper, on the eastern bank, with Otrabanda, on the western. A scant mile beyond the pontoon bridge Santa Anna Bay broadens into the Schottegat, a turning basin having two large extensions, the eastern known as Boeska Bay and the western known as Valentijn Bay. These arms of the Schottegat are separated by a peninsula on which are located extensive oil refineries. Anchorage was had by the *Velero III* in the eastern portion of the Schottegat at the mouth of Boeska Bay in 12 fathoms.

The city of Willemstad has a population of about 28,000. It is a principal port of call of many steamship lines and has excellent communications and port facilities. Its chief importance lies in its proximity to the oil fields of the Lake Maracaibo district of Venezuela. Crude oil is transported across the 35-mile channel from the mainland in shallow-draft lake boats to the great refineries of Curaçao, after which the refined petroleum is shipped to all parts of the world. Over 5,000 ships yearly clear the harbor at Willemstad, a figure comparing well with that of New York Harbor.

Air temperatures recorded in the pilot house of the *Velero III* varied from 76° F. at 2 A.M. to 81° F. at 2 P.M. the latter part of April. Light winds and moderately choppy seas, necessitating the raising of small boats at night, were recorded by ship's officers.

Three collecting stations were established in the vicinity of Willemstad: a shore collecting station on the larger island in Valentijn Bay, a visit to a large commercial dredge dump also in Valentijn Bay, and a dipping station beneath the gangway light at the *Velero III's* anchorage in the Schottegat. Difficulty was encountered in getting to Spanish Bay, an early type locality, because of the private ownership of the beach and collecting at Jan Thiel's resort at Vista Alegre was substituted. (See Charts nos. 1, 10.)

Aruba

(Collecting Stations A16-A18)

The island of Aruba lies 15 miles off the Venezuelan coast opposite the Peninsula of Paraguana. It is a barren island 4 miles wide, extending 16 miles in a northwesterly direction and having as its highest point Jamanota Hill, elevation 617 feet. The northeast side is steep and rocky. Most of the southwest side is fringed by a low-lying reef extending from ¼ to ½ mile offshore. Such harbors as there are, are behind this reef, with breaks in the reefs forming harbor entrances.

The interior of the island is excessively arid. Water conservation is a problem and has been in part solved by having oil tankers carry fresh water as ballast on their return trips. Aruba's few trees are blown by the prevailing winds until they resemble umbrellas turned inside out. (See illustration.)

Oranjestad is the principal community, appearing from the anchorage in Paarden Bay as a typical Dutch village with a steepled church in the center. It is located near the northwest end of the island and marks the limit of the barrier reef. Most of the commercial activity centers at San Nicolaas, with its huge oil refineries and extensive farms of mushroom-shaped tanks. Entrance to San Nicolaas Bay is made through a break in the reef, the channel being but 200 feet wide at one point. A pilot is necessary and vessels are moored bow and stern inside. Oil tankers dock alongside the wharf, which is amply provided with pipe lines. A strong northwesterly current flows past the harbor.

A single shore collecting station was established at Pta. Basora, the extreme southeastern tip of Aruba, directly opposite Cape San Roman on the Venezuelan coast. The beach was steep and rocky with overhanging cliffs, and collections could be made only when a wave receded. However, a good variety of material was obtained.

After departing from San Nicolaas Bay the *Velero III* made one haul in 71-96 fathoms 3 miles northwest of the bay in green mud and a series of three hauls 8 miles southwest of the bay in 23-24 fathoms, in sand, coral, coralline, and sponge. It is interesting to note that the greater depth, 96 fathoms, was close to the Aruba shore, while the lesser depth, 23 fathoms, was in the center of the channel between Aruba and the South American mainland. (See Chart no. 5.)

Velero III Atlantic Collecting Stations

The Atlantic collecting stations of the *Velero III* form a distinct unit as compared to the Pacific stations, and are so treated in the list which follows. Breaking into the Pacific series in point of chronology between stations 956-39 and 957-39, they have been given serial numbers beginning again with 1 but preceded by the letter A, which stands for Atlantic. It was thought at the time that the *Velero III* might at some future date return to Caribbean waters and add to the station list, but with her release to the United States Navy for conversion into a naval auxiliary vessel this has proved impossible, and the Atlantic list stands 59 stations, all accomplished during the month of April, 1939.

The list is a combination of navigational data, principally geographical positions expressed in latitude and longitude and depths expressed in fathoms, supplied by ship's officers, and notes on bottom or surface terrain made by the scientific staff. Of the latter, Dr. Waldo L. Schmitt of the U.S. National Museum and Mr. Fred C. Ziesenhenne and Mr. Charles Wade now of the Hancock Foundation staff were frequent contributors. Because of the completeness of the record made at the time, little supplementary information was required, but this was furnished as needed by one of the above-mentioned three.

It should be stressed that the list covers only marine collecting stations. At most of the localities mentioned, collecting of terrestrial plants, insects, and birds was accomplished; but this is not included, as land collecting covered extensive areas and precise positions could not be indicated. Again, where physical rather than biological data were sought, as in the case of water and bottom sampling, a separate set of station numbers was assigned which are not here included unless a dredge haul and water or bottom sample were taken at the same geographical position. In such a case care was taken to indicate the water or mud sample number on the dredge station list so that the physical data might be later used to supplement the biological if occasion arose.

The list, then, includes (1) dredging stations occupied by the *Velero III,* (2) dredging stations occupied by the dredge boat, (3) shore collecting stations between tide levels, (4) beach seine hauls, (5) miscellaneous diving and dipping, and (6) hook-and-line fishing, and purchases from natives of freshly caught fish. Much of the dipping was done at night under a cargo light suspended from the gangway.

In the case of dredging stations occupied by the *Velero III* the data are most complete and consist of a start and a finish position, time, and depth, and the general direction of the haul. Positions were obtained by cross bearings when possible, or by a single bearing and fathometer reading. The depth was obtained by fathometer. In the case of stations occupied by the small dredge boat, which was without instruments of navigation other than compass and lead line, the data are less complete and less accurate and consist of a starting position only. Likewise, upon the small charts accompanying the station list, *Velero III* dredging stations are indicated by arrows showing start, finish, and direction of haul, whereas small dredge boat stations are indicated merely by a cross showing the starting position. An exception is the chart of Caledonia Bay, which was of sufficiently large scale to permit the plotting of both start and finish positions of the small dredge hauls.

Often more than one haul was made to a dredging station, it being the custom to change numbers only with a marked change in position or character of the bottom. In the case of *Velero III* dredge hauls these are indicated by D-1, D-2, etc. In the case of the small dredge these are not indicated except again at Caledonia Bay, and there only on the chart and not on the list. Specimens from the various dredges of one station were combined, regardless of whether taken by the *Velero III* or small dredge boat, but the full data of each haul were preserved in order that scientists working over the collections from a given station might know that the station represented a fair sampling of the area, rather than a single cross-section.

The designation "a," as in station A44a-39, is employed in quite another sense than are D-1 and D-2, which indicate fractions of the same station, specimens of which were not kept separate. It occasionally happened that two collectors, working independently, each assigned the next consecutive station number to specimens taken at widely separated localities. When this error was discovered, it was rectified by adding the small letter "a" to one of the stations, thus requiring a minimum alteration of specimen labels. It therefore is the equivalent of an independent station having no relation to the station of the same number without the "a."

Specimens have been kept separate and are so labeled. This point was unfortunately not made clear in the explanation of the Pacific station list, some of the D-1 and D-2 indications having been changed to a, b, and c in the final compilation.

No indications of the type of dredging gear used have been made on the station list. It is understood that from the *Velero III* a standard-type steel dredge with a 3′ 6″ beam was used, sometimes with, but more generally without, cotton swabs attached. From the small dredge boat the same type dredge with a smaller beam was used. The muddy shallows of Caledonia Bay and the shoals of Colombia and Venezuela would have been ideal for beam trawling, but such equipment was not put into operation on the *Velero III* until 1940.

To facilitate the use of the list without the necessity of consulting navigational charts and plotting positions, stations are grouped according to countries visited, and general localities are indicated by place names.

ALLAN HANCOCK ATLANTIC EXPEDITION OF 1939

Velero III Station Record — CARIBBEAN CRUISE — April 2-28, 1939

Sta. No.	*Date*	*General Locality*	*Dredge Down* *Position*	*Time*	*Fms.*	*Dir.*	*Dredge Up* *Position*	*Time*	*Fms.*	*Remarks*
			Panama							
	April 1939									
A1 -39	3	Caledonia Bay	8 53 40 N 77 40 30 W		shore					Reef and dipping
A2 -39	3	Caledonia Bay	8 54 07 N 77 41 15 W		1				7	Mud and fine sand
A3 -39	3	Caledonia Bay	8 52 43 N 77 41 40 W		shore					Brackish water
A4 -39	3	Caledonia Bay	8 53 15 N 77 40 45 W		8				14	Mud and shell
A5 -39	3	Caledonia Bay	8 53 40 N 77 40 30 W		1					Diving helmet
A6 -39	3	Caledonia Bay	8 53 22 N 77 41 30 W		shore					Sandy beach, Seine
A7 -39	4	Caledonia Bay	8 53 03 N 77 41 20 W		1				5	Hard sand
A8 -39	4	Caledonia Bay	8 53 43 N 77 41 25 W		shore					Rock
A9 -39	4	Caledonia Bay	8 52 43 N 77 41 40 W		shore					Fresh-water stream bank
A10-39	4	Outside Caledonia Bay	8 54 43 N 77 38 25 W	5:32 PM	28		8 54 49 N 77 38 15 W	5:47 PM	29	Gray mud

Sta. No.	Date	General Locality	Dredge Down Position	Time	Fms.	Dir.	Dredge Up Position	Time	Fms.	Remarks
			Colombia							
A11-39	6	Barranquilla, near Terminal	10 58 40 N 74 46 10 W		shore					Muddy swamp
A12-39	7	11 mi. S.W. of Cape la Vela	12 04 30 N 72 14 45 W		surface					Electric light
A12a-39	8	11 mi. S.W. of Cape la Vela	12 04 30 N 72 14 45 W		5					Sargassum off anchor chain
A13-39 D-1	8	1 mi. S.W. of Cape la Vela	12 12 35 N 72 10 45 W	7:10 AM	13		12 12 17 N 72 11 00 W	7:20 AM	13	Gray sand
A13-39 D-2	8	1 mi. S.W. of Cape la Vela	12 12 14 N 72 10 25 W	7:37 AM	10		12 12 27 N 72 10 23 W	7:48 AM	10	Gray sand
A14-39 D-1	8	2 mi. S.W. of Cape la Vela	12 11 55 N 72 11 30 W	8:20 AM	22		12 11 52 N 72 11 20 W	8:32 AM	21	Gray sand
A14-39 D-2	8	2 mi. S.W. of Cape la Vela	12 11 50 N 72 11 20 W	8:43 AM	21		12 11 50 N 72 11 16 W	8:56 AM	21	Gray sand
A15-39 D-1	8	2 mi. off Bahia Honda	12 24 37 N 71 47 25 W	12:46 PM	9	198°	12 24 23 N 71 47 31 W	12:55 PM	10	Coralline
A15-39 D-2	8	2 mi. off Bahia Honda	12 24 19 N 71 46 25 W	1:19 PM	9	123°	12 24 28 N 71 46 38 W	1:32 PM	10	Coralline
			Netherlands West Indies							
A16-39	10	Pta. Basora, Aruba	12 25 00 N 69 52 15 W		shore					Steep, rocky beach
A17-39	10	3 mi. N.W. of San Nicolaas Bay, Aruba	12 26 55 N 69 58 00 W	1:38 PM	71	156°	12 26 17 N 69 57 38 W	1:53 PM	96	Green mud

Sta. No.	Date	General Locality	Dredge Down Position	Dredge Down Time	Fms.	Dir.	Dredge Up Position	Dredge Up Time	Fms.	Remarks
A18-39 D-1	10	8 mi. S.W. of San Nicolaas Bay, Aruba	12 21 28 N 70 04 45 W	3:36 PM	23	178°	12 21 02 N 70 04 40 W	3:48 PM	24	Coralline and sponge
A18-39 D-2	10	8 mi. S.W. of San Nicolaas Bay, Aruba	12 21 02 N 70 04 45 W	4:00 PM	24	280°	12 21 05 N 70 05 35 W	4:15 PM	23	Sand and coral
A18-39 D-3	10	8 mi. S.W. of San Nicolaas Bay, Aruba	12 21 05 N 70 05 40 W	4:21 PM	23	300°	12 21 30 N 70 06 15 W	4:36 PM	24	Sand and coral
			Venezuela							
A19-39	12	Valencia Lake	10 15 45 N 67 42 00 W		inland					Fresh water
A20-39	13	Tortuga Island	10 58 00 N 65 23 15 W		shore					Coral rock
A21-39	13	Tortuga Island	10 58 00 N 65 23 15 W		shore					Beach seine
A22-39	13	Tortuga Island	10 58 30 N 65 24 00 W		2				5	Coral sand, algae
A23-39	13	Tortuga Island	10 58 30 N 65 24 45 W		surface					Electric light
A24-39	14	Cubagua Island	10 47 55 N 64 13 53 W		2				5	Sand and algae
A25-39	14	Cubagua Island	10 48 48 N 64 13 30 W		shore					Coral rock
A26-39	14	Cubagua Island	10 48 48 N 64 14 30 W		surface					Electric light
A27-39	15	Cubagua Island	10 47 55 N 64 13 53 W		2				5	Coarse black sand

Sta. No.	Date	General Locality	Dredge Down Position	Dredge Down Time	Fms.	Dir.	Dredge Up Position	Dredge Up Time	Fms.	Remarks
A28-39	15	Cubagua Island	10 49 25 N 64 16 00 W		2					Algae
A29-39	15	Cubagua Island	10 49 25 N 64 16 00 W		2					Mud
A30-39	15	Cubagua Island	10 48 48 N 64 13 30 W		shore					Rocky
A31-39	15	1½ mi. S.E. of Cubagua Island	10 47 48 N 64 07 54 W	2:22 PM	13	143°	10 47 30 N 64 07 40 W	2:30 PM	13	Sandy mud
A32-39 D-1	15	3 mi. N. of Coche Island	10 50 30 N 63 54 30 W	4:03 PM	21	195°	10 50 05 N 63 54 40 W	4:17 PM	22	Coarse sand and shell
A32-39 D-2	15	3 mi. N. of Coche Island	10 50 30 N 63 54 50 W	5:04 PM	19	90°	10 50 30 N 63 54 42 W	5:17 PM	33	Sand and shell
A33-39	15	3 mi. N. of Coche Island	10 50 07 N 63 55 00 W	4:36 PM	22	247°	10 50 05 N 63 55 10 W	4:48 PM	31	Mud and shell
			British West Indies							
A34-39	18	Port of Spain, Trinidad	10 38 37 N 61 30 47 W		shore					Fish market
A35-39	18	Port of Spain, Trinidad	10 30 39 N 61 37 30 W		1				3	Sand and algae
A36-39	18	West Manzanilla, Trinidad	10 30 20 N 61 02 37 W		shore					Estuary behind sand bar
A37-39	18	Port of Spain, Trinidad	10 38 12 N 61 32 08 W		surface					Electric light
A38-39	19	Rockly Bay, Tobago Island	11 10 20 N 60 43 30 W		9				18	Mud

Sta. No.	Date	General Locality	Dredge Down Position	Time	Fms.	Dir.	Dredge Up Position	Time	Fms.	Remarks
A39-39	19	Rockly Bay, Tobago Island	11 10 58 N 60 43 47 W		shore					Beach seine
A40-39	20	Buccoo Bay, Tobago Island	11 10 42 N 60 48 07 W		shore					Beach seine
A41-39	20	Buccoo Reef, Tobago Island	11 11 20 N 60 49 36 W		shore					Coral reef
			Venezuela							
A42-39 D-1	21	7 mi. N. of Margarita Island	11 10 43 N 64 16 47 W	8:54 AM	21	320°	11 11 18 N 64 17 15 W	9:12 AM	22	Sand and shell
A42-39 D-2	21	4 mi. N. of Margarita Island	11 07 36 N 64 18 15 W	9:52 AM	17	286°	11 07 42 N 64 18 34 W	10:05 AM	18	Sand and shell
A43-39	21	7 mi. N. of Tortuga Island	11 04 30 N 65 12 00 W	2:35 PM	40	75°	11 06 00 N 65 11 00 W	2:58 PM	41	Sand and shell
A44-39	21	4 mi. N. of Tortuga Island	11 02 30 N 65 14 45 W	3:36 PM	21	45°	11 03 30 N 65 14 00 W	3:47 PM	22	Dead coral
			Netherlands West Indies							
A44a-39	22	Island in Valentijn Bay, Curaçao	12 07 25 N 68 56 12 W		shore					
A45-39	23	Santa Anna Harbor, Curaçao	12 07 22 N 68 55 40 W		shore					Dredge dump
A46-39	23	Vista Alegre, Curaçao	12 00 30 N 68 53 20 W		shore					Bathing beach, Jan Thiel's Resort
A47-39	23	Schottegat, Santa Anna Harbor, Curaçao	12 07 03 N 68 55 34 W		surface					Electric light

Sta. No.	Date	General Locality	Dredge Down Position	Dredge Down Time	Fms.	Dir.	Dredge Up Position	Dredge Up Time	Fms.	Remarks
			Colombia							
A48-39	25	5 mi. N.W. of Galera Point light	10 51 55 N 75 18 00 W	1:43 PM	12	290°	10 52 35 N 75 19 50 W	1:51 PM	12	Sand
			Panama							
A49-39	26	Caledonia Bay	8 53 25 N 77 41 30 W		shore					Beach seine
A50-39	26	Caledonia Bay	8 53 38 N 77 41 25 W		shore					Rocky reef
A51-39	26	Caledonia Bay	8 55 40 N 77 43 05 W		shore					Indian village
A52-39	26	Caledonia Bay	8 53 43 N 77 41 18 W		5					Coarse sand, rocks
A53-39	26	Caledonia Bay	8 53 33 N 77 41 09 W		7				12	Mud
A54-39	26	Caledonia Bay	8 53 40 N 77 41 08 W		surface					Electric light
A55-39	26	Caledonia Bay	8 53 40 N 77 40 27 W		Hand line					Rocky reef
A56-39	27	Caledonia Bay	8 53 40 N 77 40 27 W		shoal					Skiff on reef
A57-39	27	Caledonia Bay	8 53 43 N 77 41 30 W		shore					Mainland reef
A58-39	27	Caledonia Bay	8 52 43 N 77 41 40 W		shore					Brackish water
A59-39	27	Caledonia Bay	8 53 40 N 77 41 08 W							From fishermen

EXPEDITION CHARTS

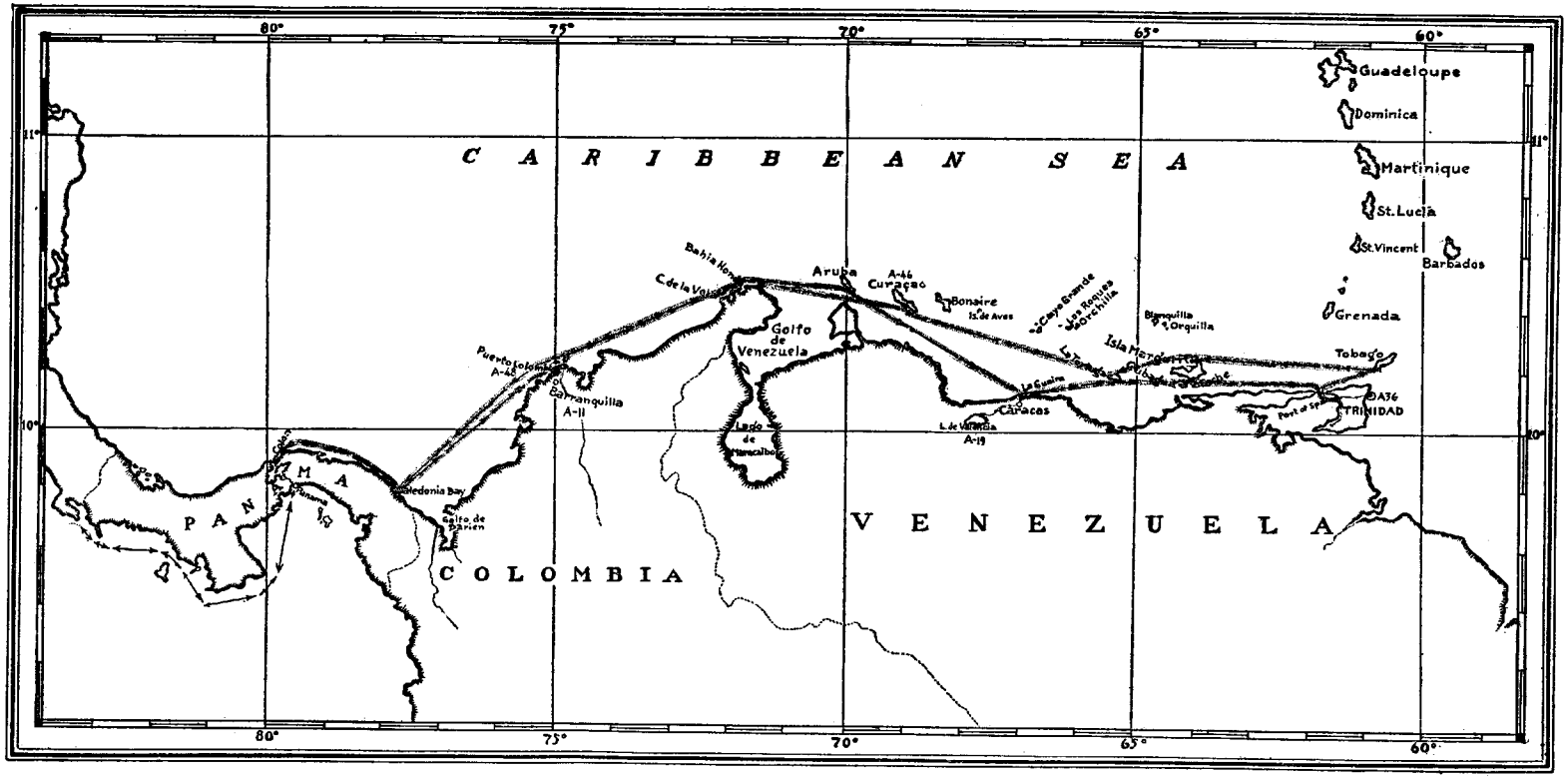

80°
75°
70°
65°
60°
11°
10°
CARIBBEAN SEA
Guadeloupe
Dominica
Martinique
St. Lucia
St. Vincent
Barbados
Grenada
Tobago
TRINIDAD
Aruba
A-46
Curaçao
Bonaire
Is. de Aves
Cayo Grande
Los Roques
Orchilla
Blanquilla
Orquilla
Isla Margarita
Bahia Honda
C. de la Vela
Puerto Colombia
A-46
Barranquilla
A-11
Golfo de Venezuela
Lago de Maracaibo
La Guaira
Caracas
L. de Valencia
A-19
Port of Spain
A36
Golfo de Darien
COLOMBIA
VENEZUELA
PANAMA

Chart 1

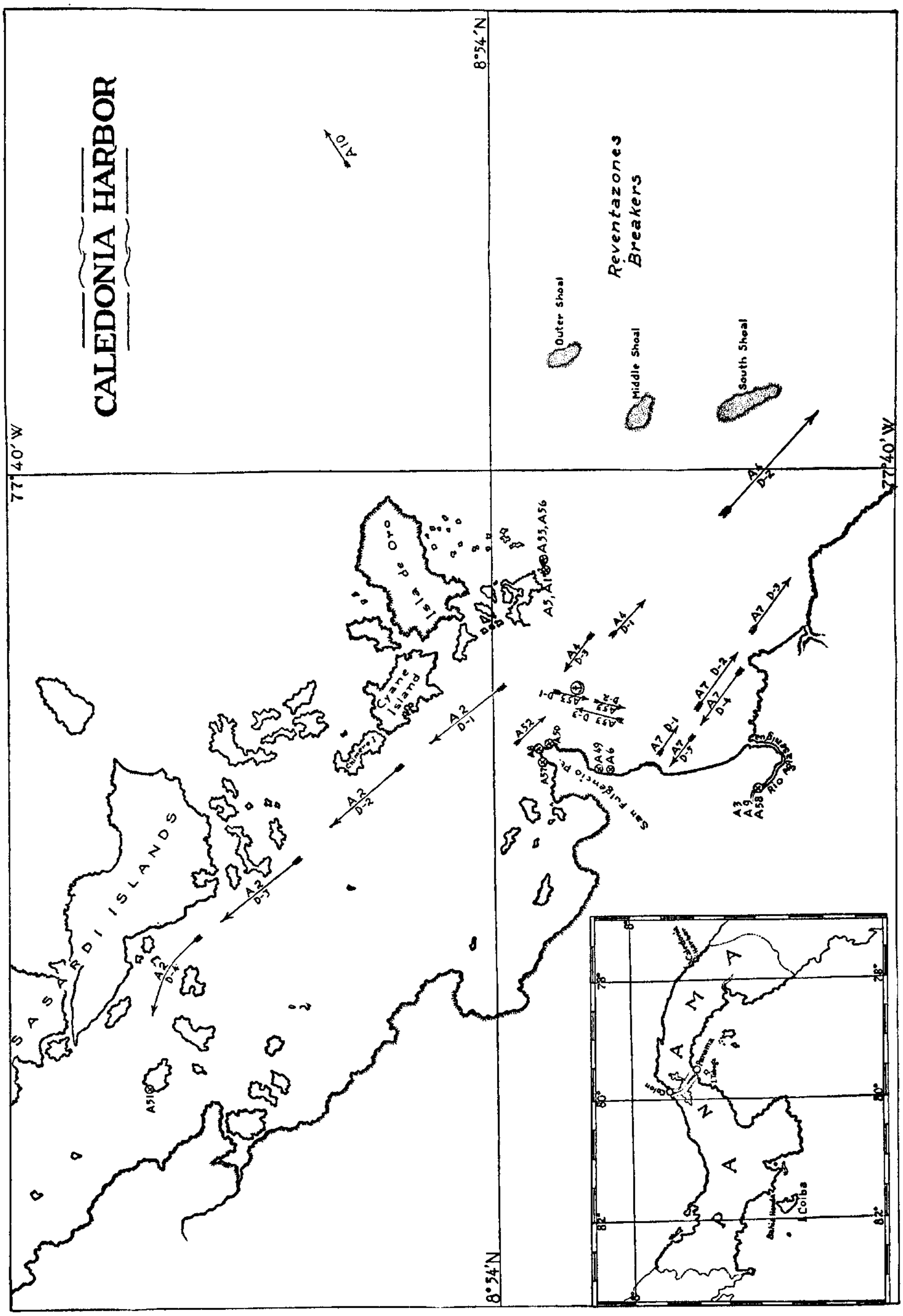
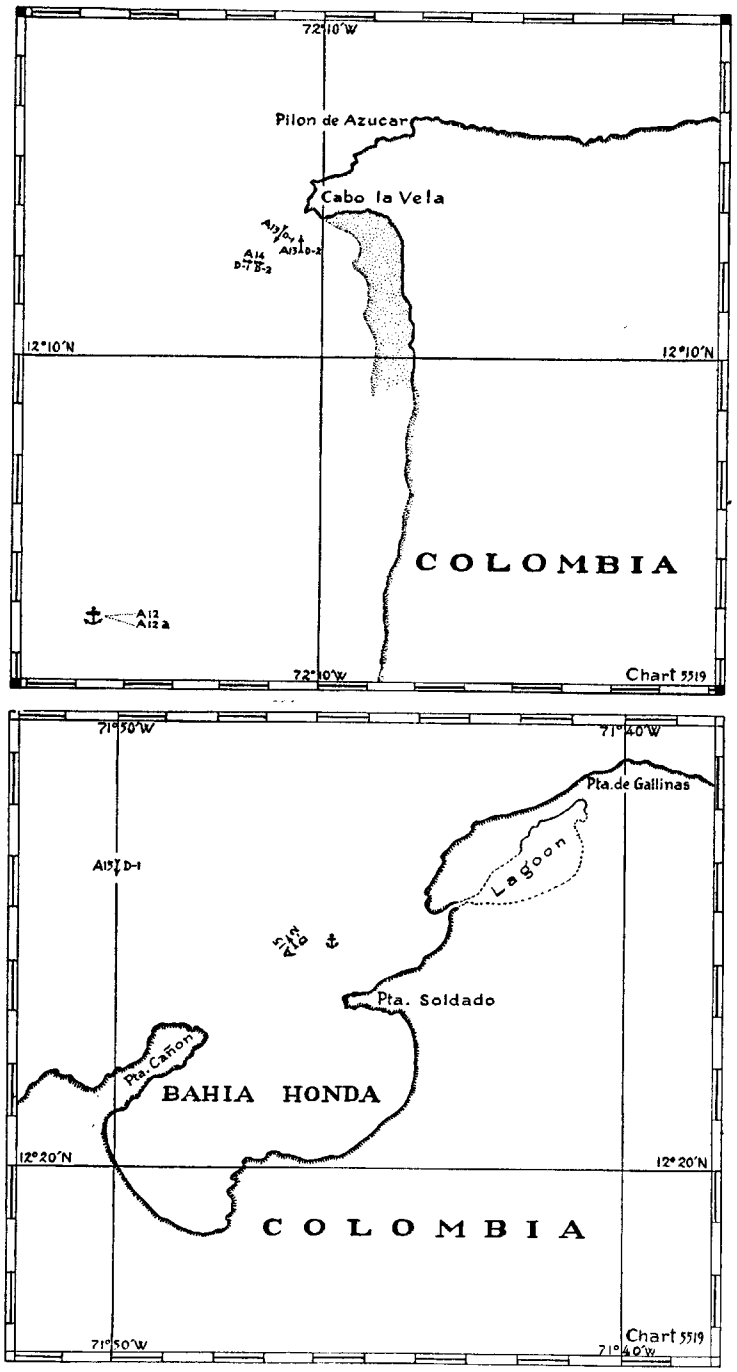

CALEDONIA HARBOR
77°40'W
8°54'N
Reventazones Breakers
Outer Shoal
Middle Shoal
South Shoal
Isla de Oro
Cyane Island
SASARDI ISLANDS
San Fulgencio Pt.
PANAMA
Colon
Panama
Coiba

Chart 2



Charts 3 and 4

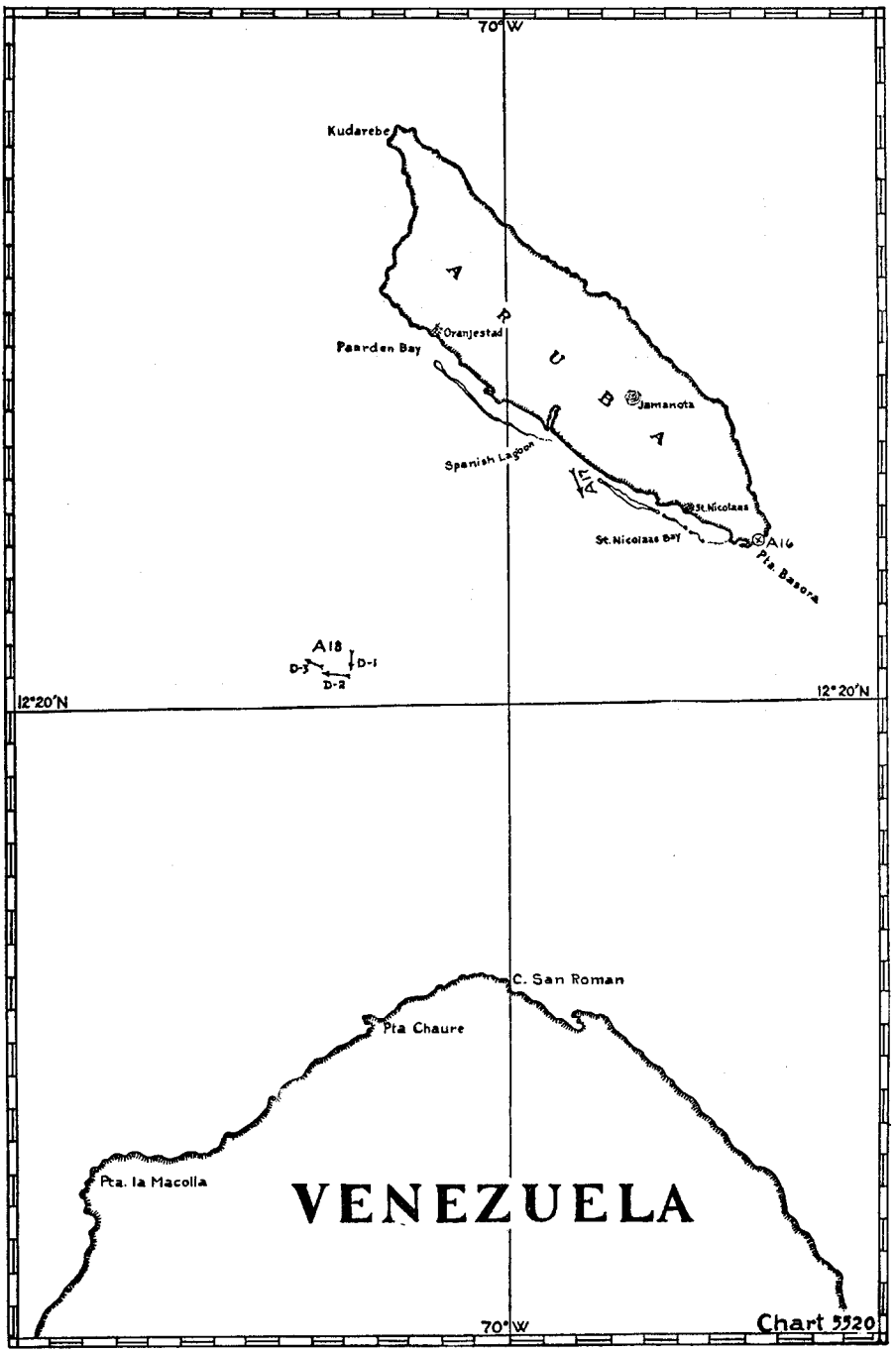

70°W
Kudarebe
ARUBA
Oranjestad
Paarden Bay
Jamanota
Spanish Lagoon
St. Nicolaas
St. Nicolaas Bay
A16
Pta. Basora
A18
D-3
D-1
D-2
12°20'N
12°20'N
C. San Roman
Pta Chaure
Pta. la Macolla
VENEZUELA
70°W
Chart 5520

Chart 5

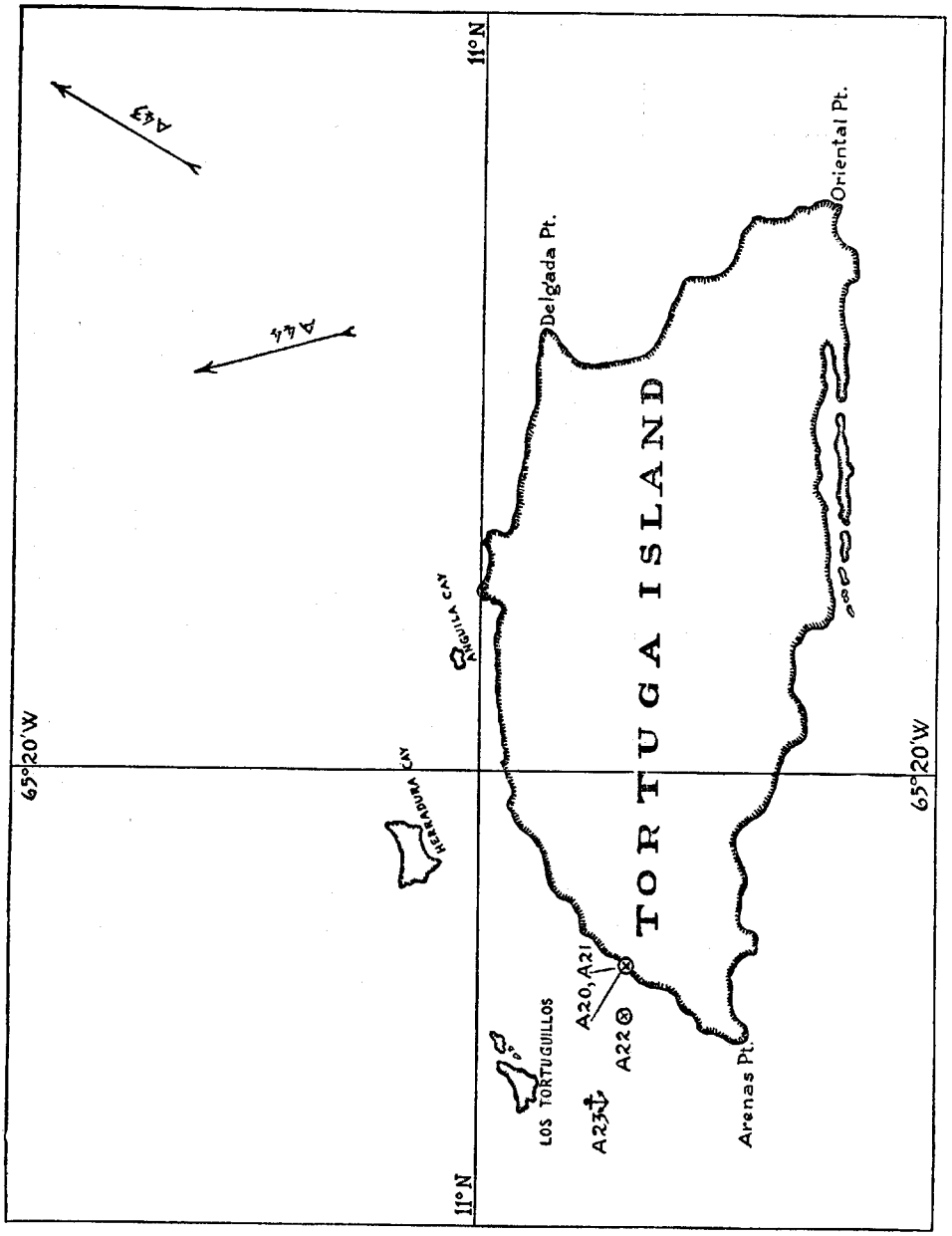

A43
A44
11°N
65°20'W
ARENILLA CAY
HERRADURA CAY
Delgada Pt.
Oriental Pt.
TORTUGA ISLAND
LOS TORTUGUILLOS
A20, A21
A22
A23
Arenas Pt.
11°N
65°20'W

Chart 6

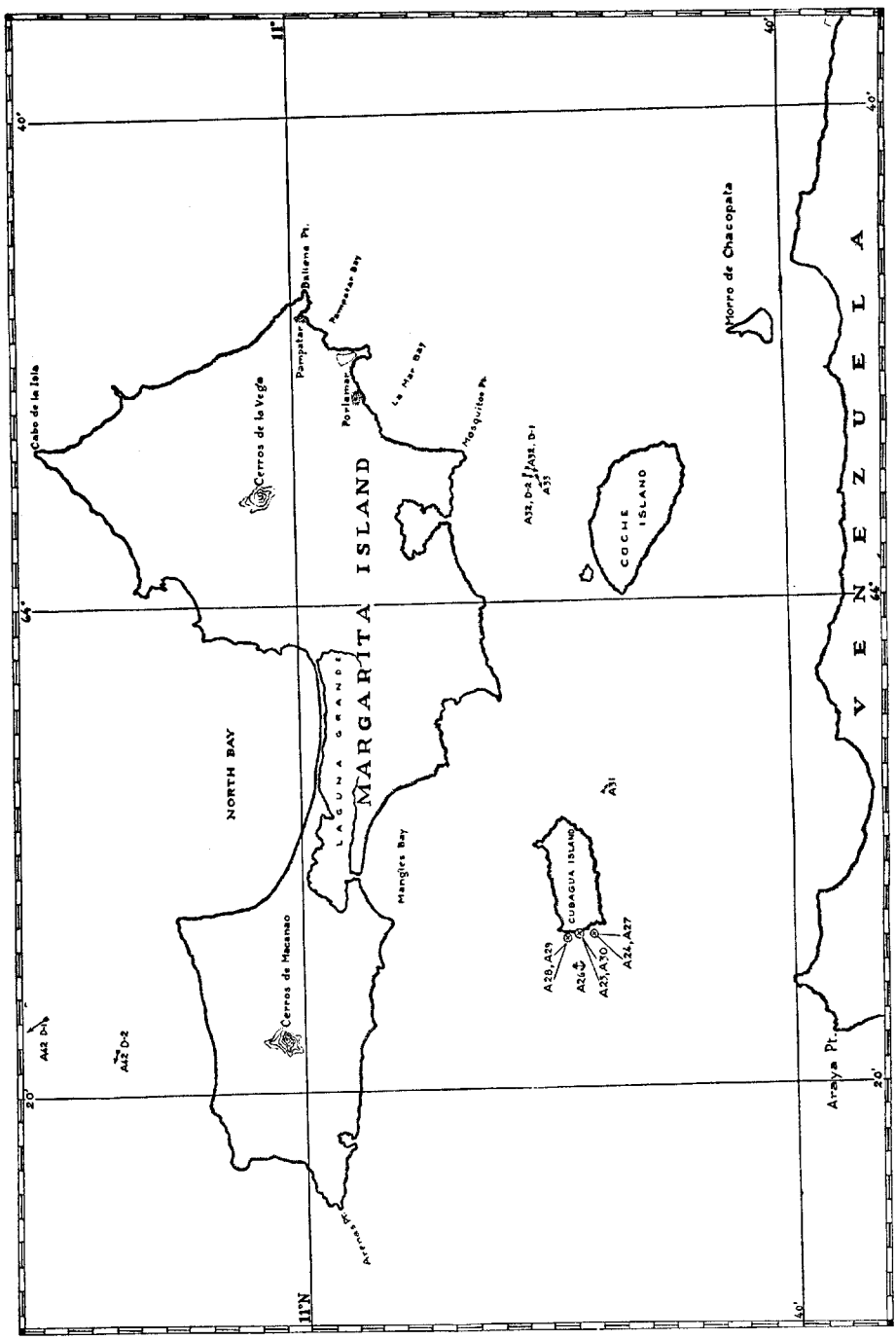

MARGARITA ISLAND
VENEZUELA
NORTH BAY
LAGUNA GRANDE
Mangles Bay
Cerros de la Vega
Cerros de Macanao
Cabo de la Isla
Pampatar
Ballena Pt.
Porlamar
Pamatar Bay
La Mar Bay
Mosquitos Pt.
Morro de Chacopata
COCHE ISLAND
CUBAGUA ISLAND
A28, A29
A26
A25, A30
A24, A27
A31
A32, D-2
A33, D-1
A35
A12 D-1
A12 D-2
Araya Pt.
Arenas Pt.
11°N
64°
40'
20'

Chart 7

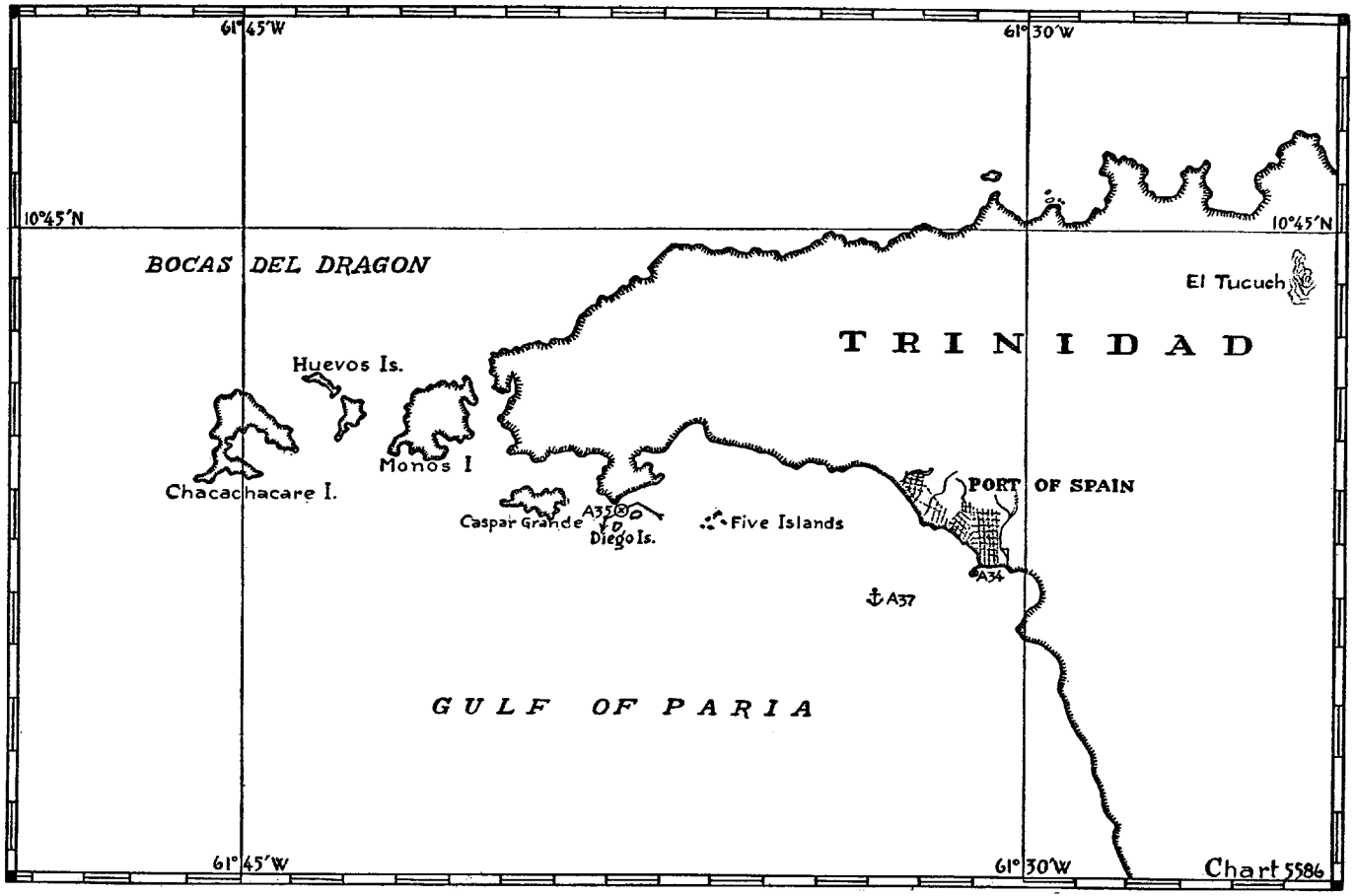

61°45'W
61°30'W
10°45'N
10°45'N
BOCAS DEL DRAGON
El Tucuche
TRINIDAD
Huevos Is.
Monos I
Chacachacare I.
Caspar Grande
A35
Diego Is.
Five Islands
PORT OF SPAIN
A34
A37
GULF OF PARIA
61°45'W
61°30'W
Chart 5586

Chart 8

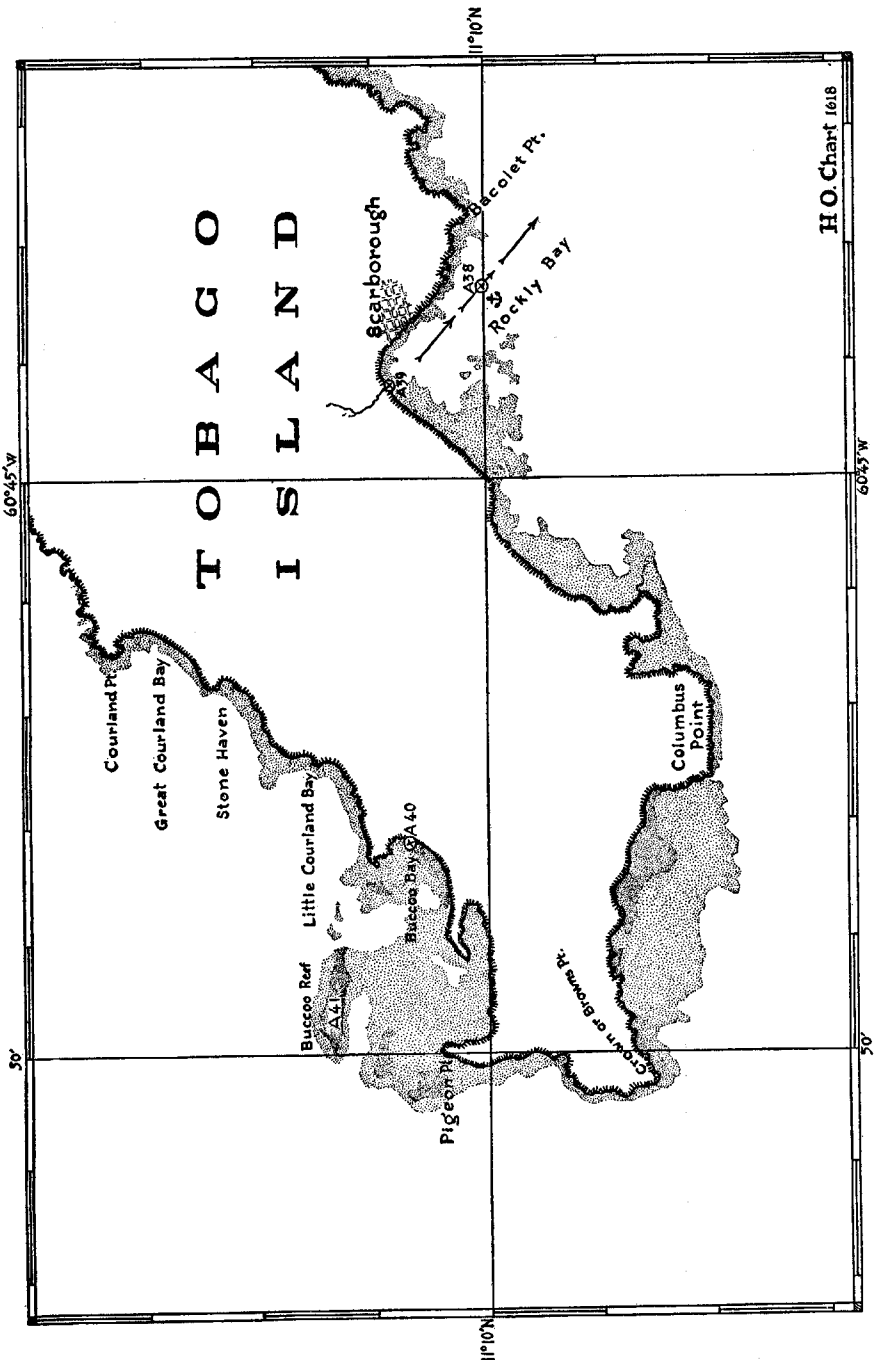

TOBAGO
ISLAND
Scarborough
Bacolet Pt.
Rocky Bay
A38
A39
H.O. Chart 1618
11°10'N
60°45'W
50'
Courland Pt.
Great Courland Bay
Stone Haven
Little Courland Bay
Bucco Bay
A40
Bucco Reef
A41
Pigeon Pt.
Crown or Browns Pt.
Columbus Point

Chart 9

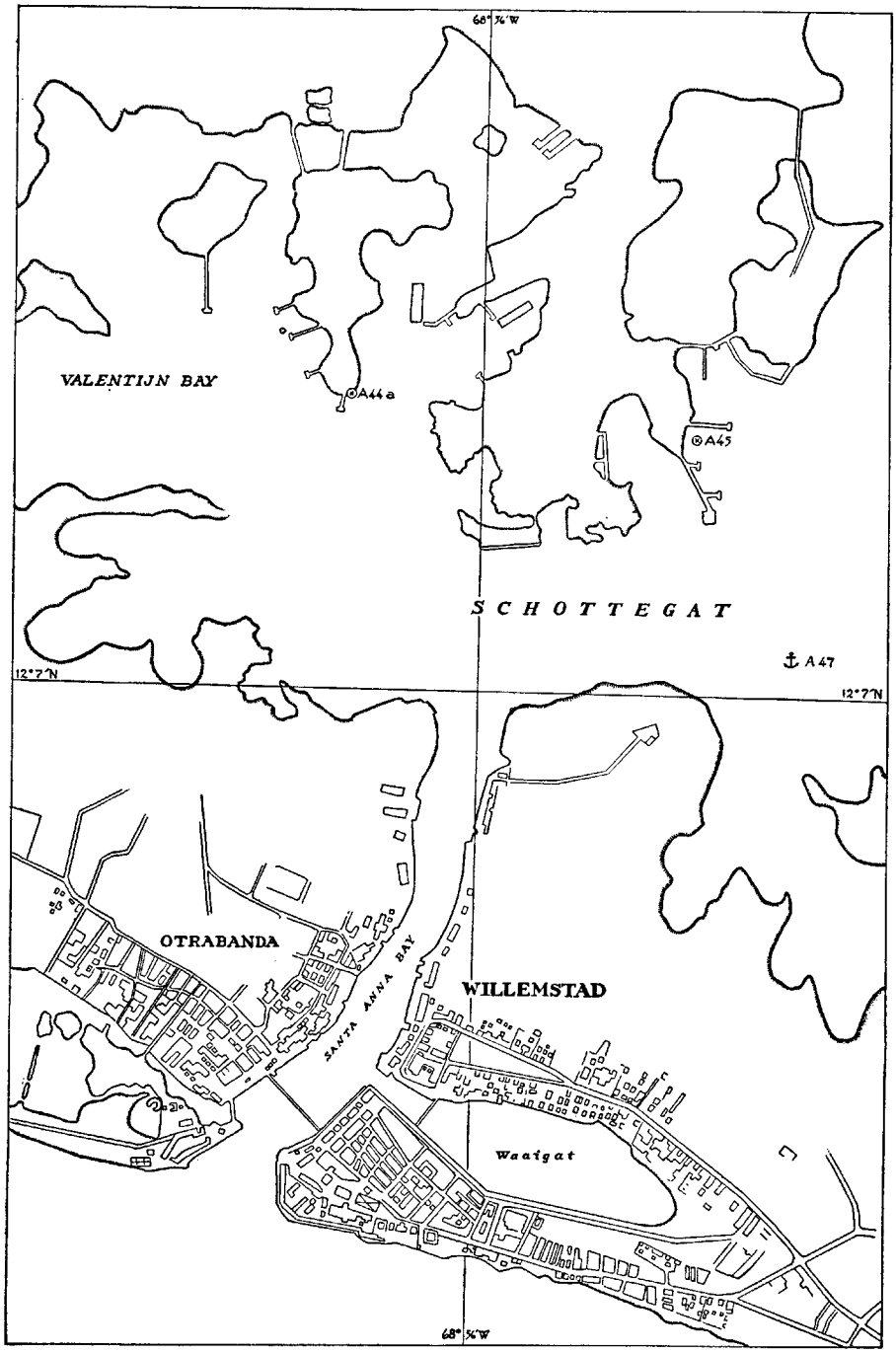

68° 56'W
VALENTIJN BAY
A44a
A45
SCHOTTEGAT
A47
12° 7'N
12° 7'N
OTRABANDA
SANTA ANNA BAY
WILLEMSTAD
Waaigat
68° 56'W

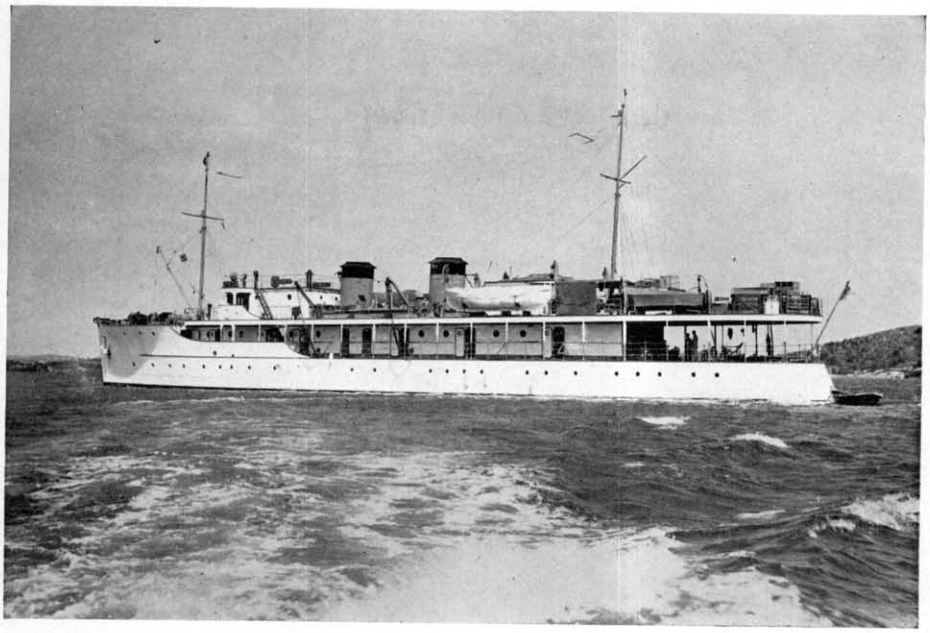
Chart 10

PLATES
AND
EXPLANATIONS

PLATE 1

Fig. 1. Exploration Cruiser *Velero III,* anchored in Santa Anna Harbor, Curaçao, Netherlands West Indies.

Fig. 2. View aft from the bridge of the *Velero III,* showing sounding machine and port launch beyond ladder, taken while passing through the old French Canal built by de Lesseps, Panama.



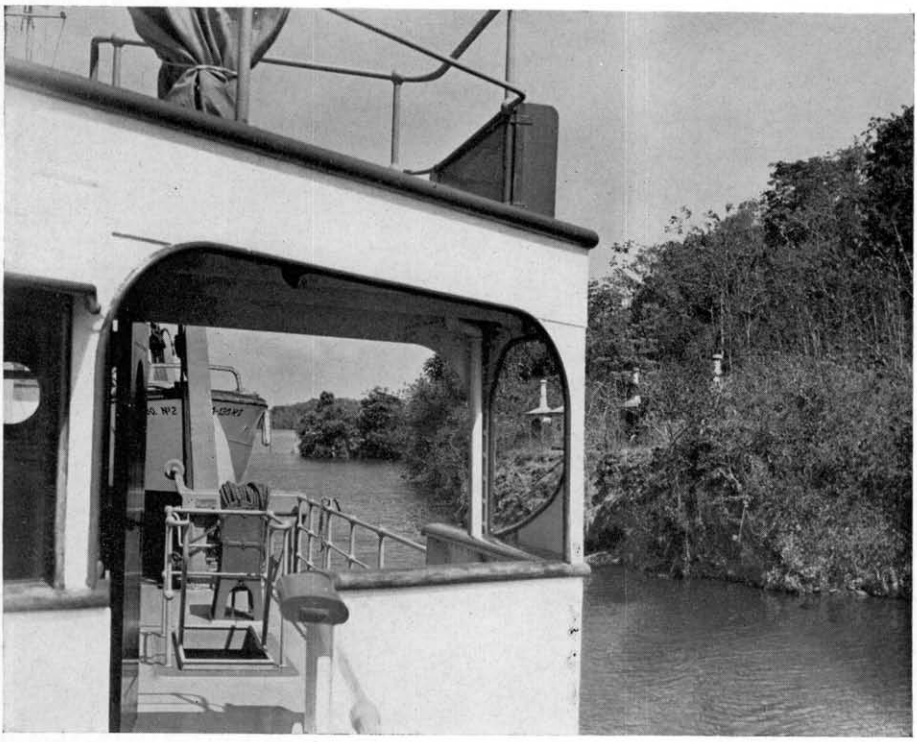
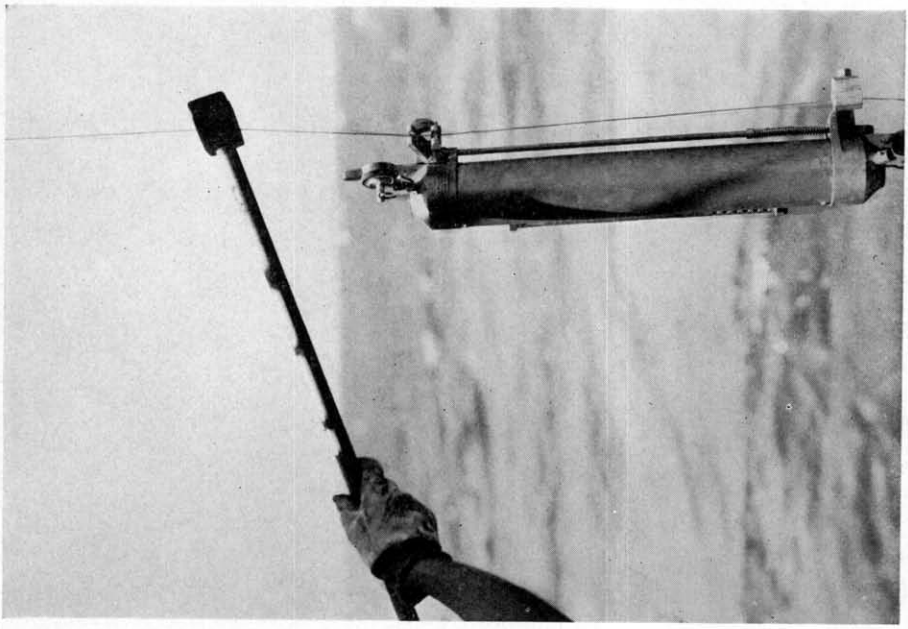


PLATE 2

Fig. 3. Captain Allan Hancock at controls of Lietz sounding machine during water and bottom sampling operations.

Fig. 4. Preparing to lower Atlas reversing water bottle, reversing mechanism to be later tripped by messenger.



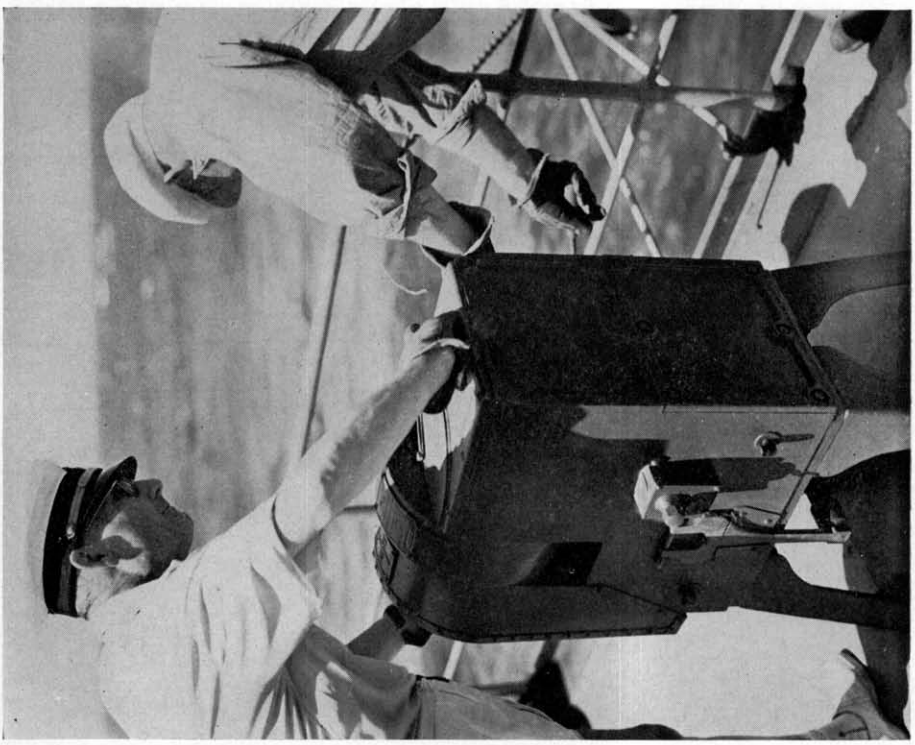
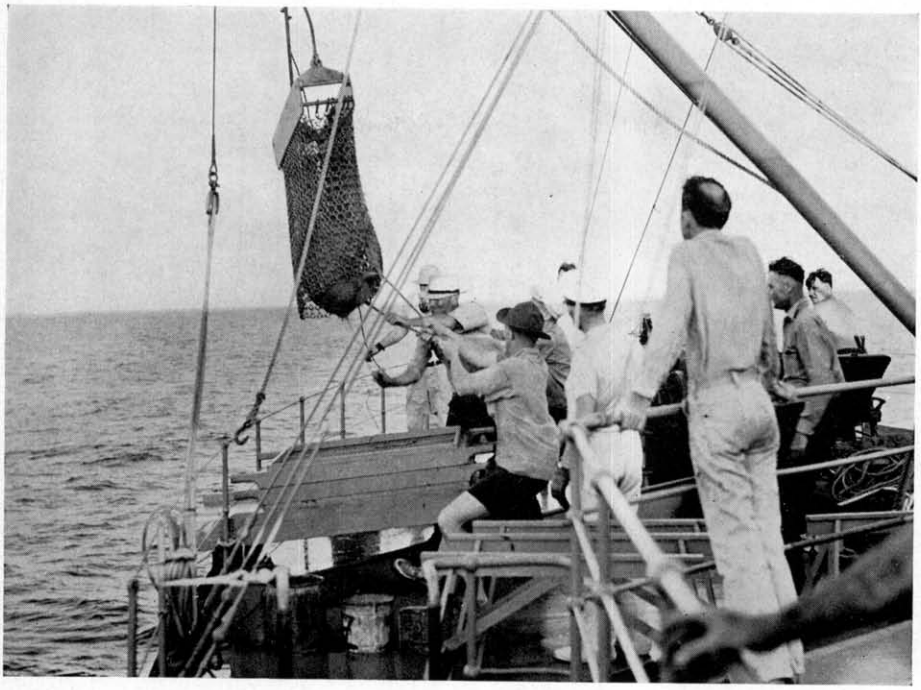


PLATE 3

Fig. 5. Loaded dredge being hoisted aboard by means of ship's boom. Crew members about to pull rip cord by means of which the contents of inner bag are quickly emptied upon the dredging table.

Fig. 6. Dr. Waldo L. Schmitt of the United States National Museum, sieving mud dredged from the bottom of the Caribbean in search of Crustacea.



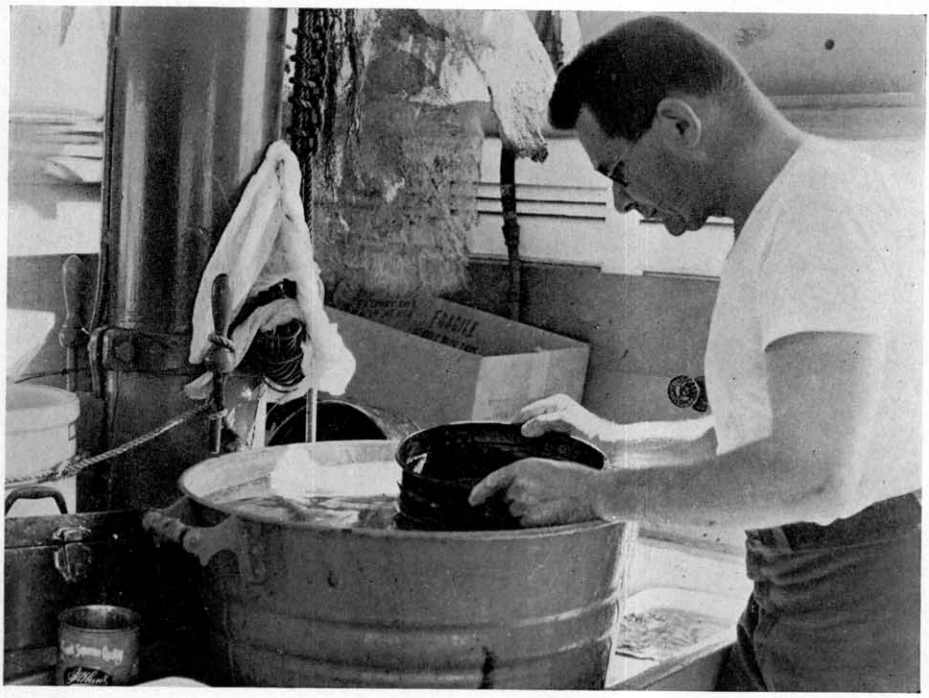
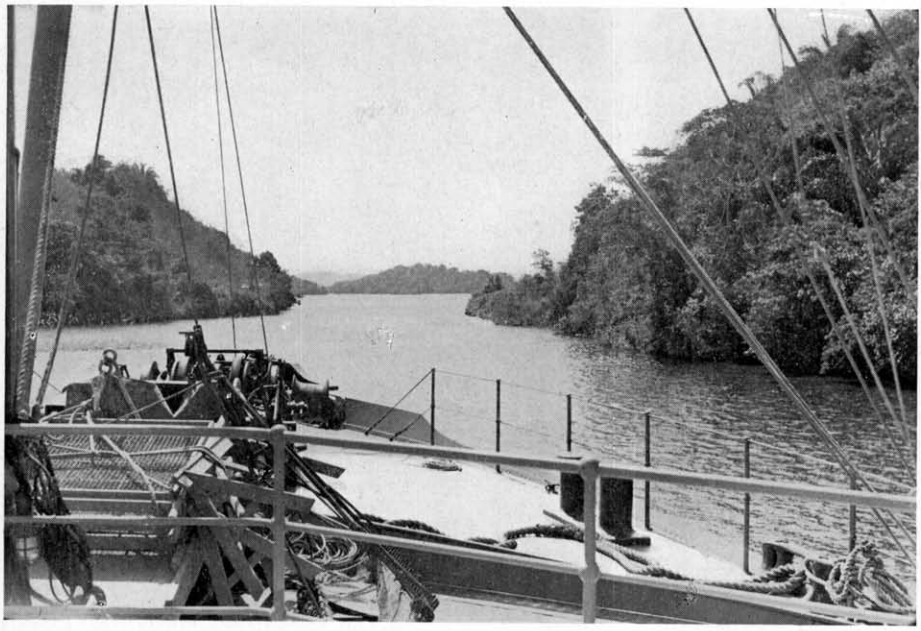

FRAGILE

PLATE 4

Fig. 7. View over the fo'c's'l head of the *Velero III* toward narrow portion of the old French Canal, Panama. Dredging gear firmly lashed in anticipation of Atlantic gales.

Fig. 8. San Blas Indian village at Caledonia Bay, Panama, as seen from the mainland.



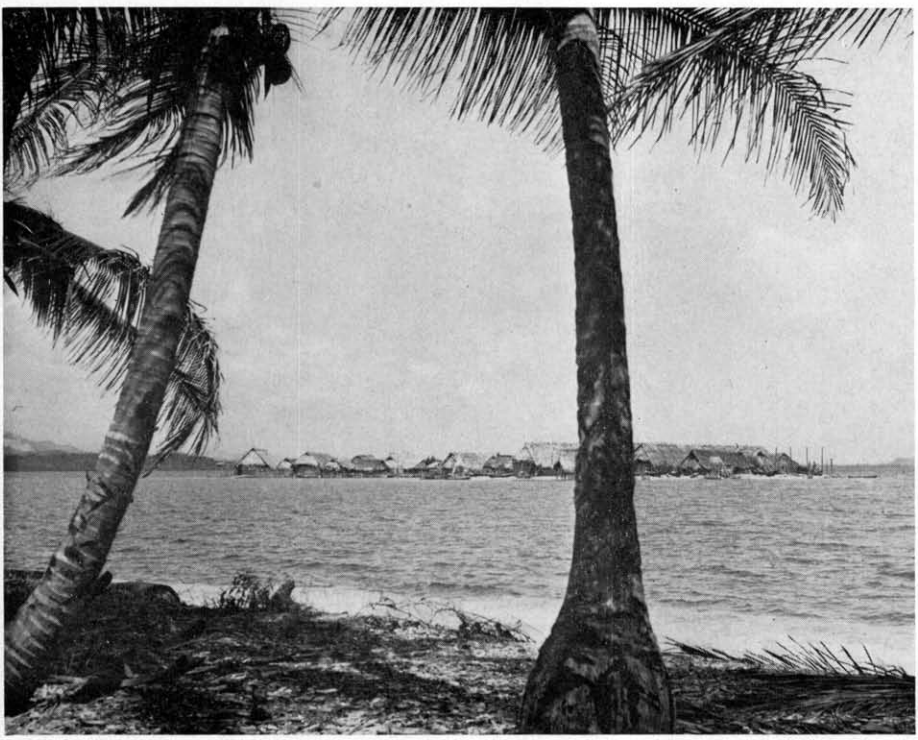


PLATE 5

Fig. 9. San Blas Indian village, Caledonia Bay, Panama, showing watch tower apparently used for signaling to sailing craft at sea.

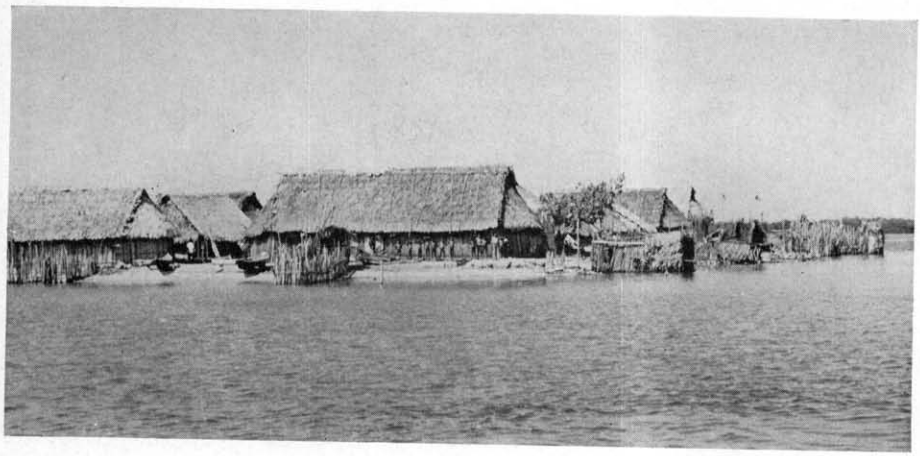
Fig. 10. Beached canoes, Panamanian flag, and tribal assembly hall. Only men were allowed to enter this building.

PLATE 6

Fig. 11. San Blas Indian village, Caledonia Bay, Panama, seen from one of the expedition launches. About twenty naked boys are standing on the beach.

Fig. 12. Low fringe of cays or islands which separate Caledonia Bay, Panama, from the open sea and sailing canoe used by natives in navigating the shallow waters.

Fig. 13. Crude breakwater, formed of coral blocks and piling, behind which native canoes take shelter in heavy weather. Nameless 210-foot island in center background, Sasardi Point at left.



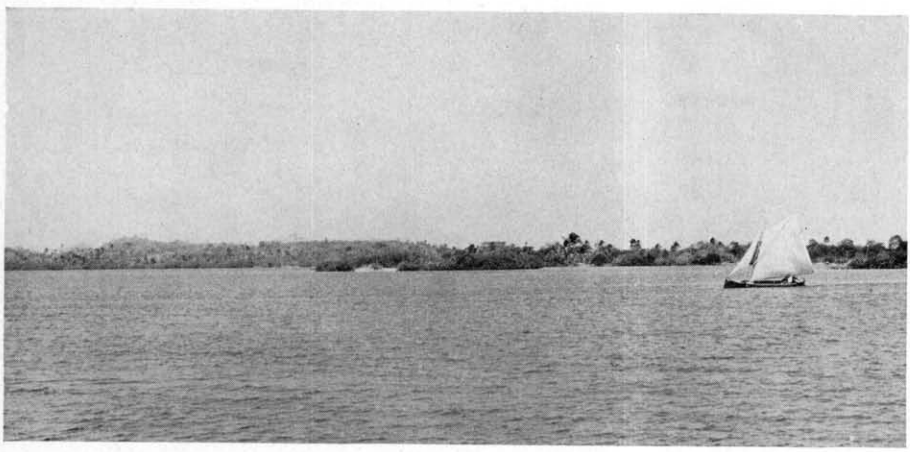
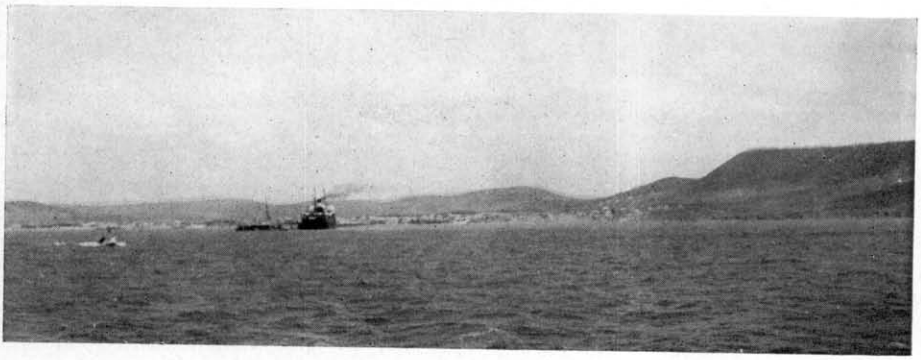


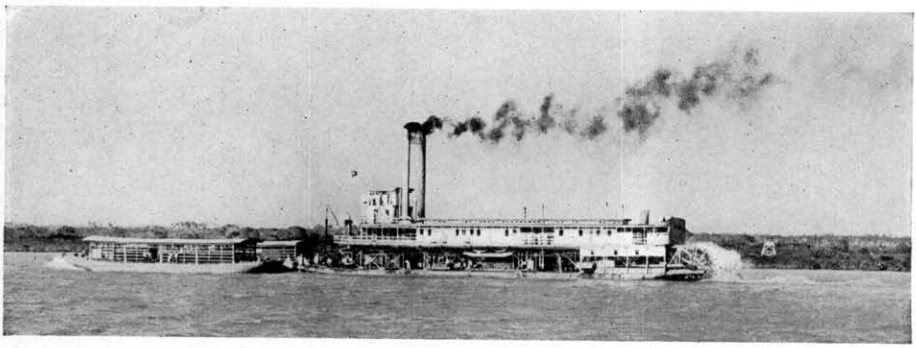
PLATE 7

Fig. 14. Puerto Colombia, seen from the *Velero III* at anchor about a mile offshore. A wharf at which a freighter is moored extends out two thirds of this distance. Vessels must call here to take on Magdalena River pilots for Barranquilla.

Fig. 15. Magdalena River steamer pushing two barges. Stern wheelers which have outlived their usefulness on the Mississippi, add many years to their lives in service on South American rivers.

Fig. 16. *Velero III,* preparing to tie up alongside modern steel and concrete dock at Barranquilla, Colombia, as stern-wheel river boat backs away.





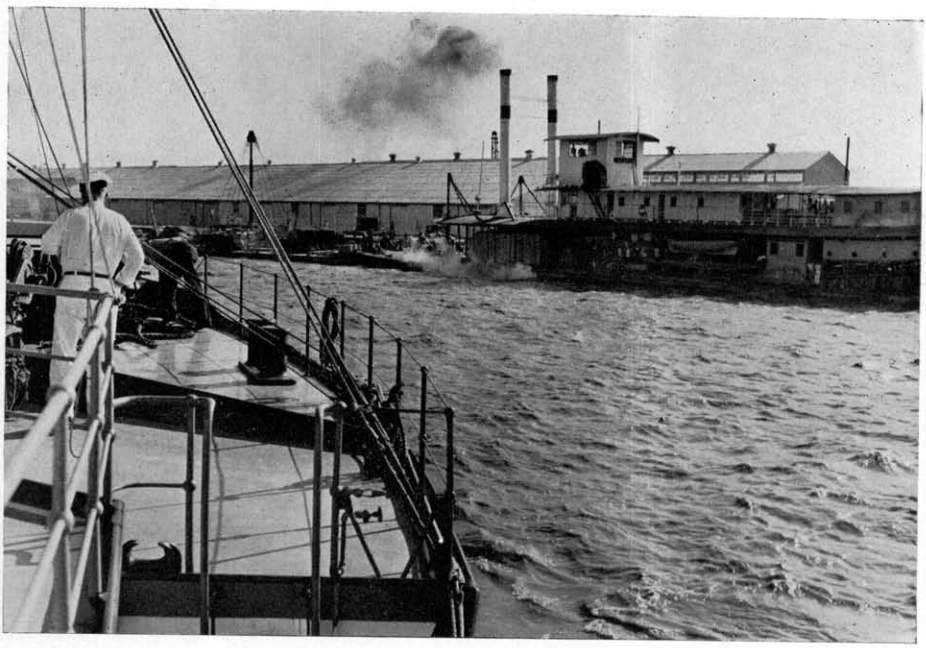


PLATE 8

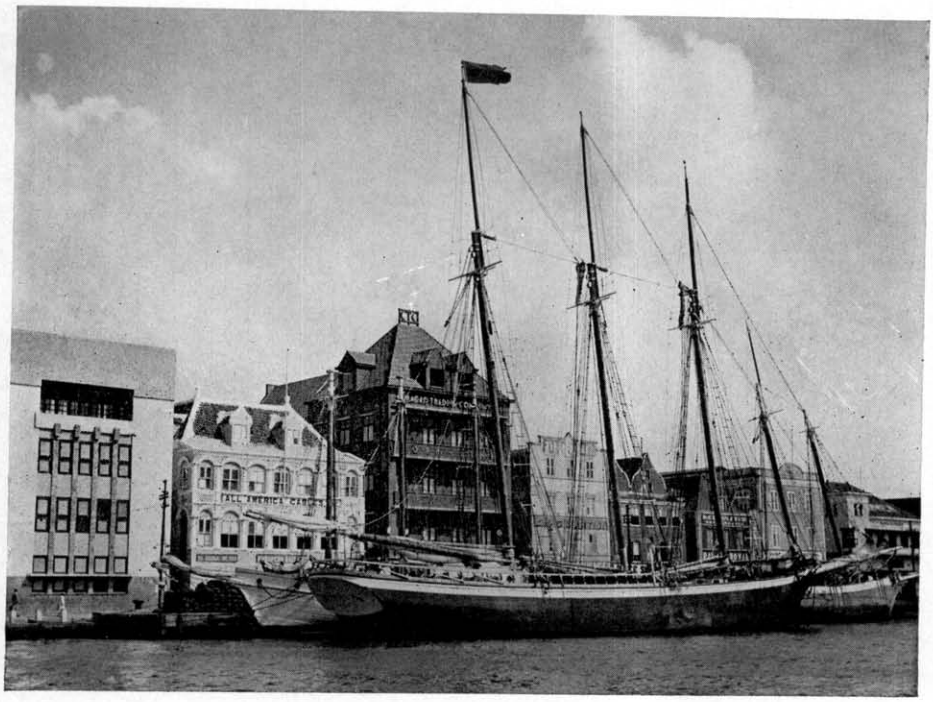
Fig. 17. A busy corner near the market place at Barranquilla, Colombia. Produce arrives by sailboat or canoe and is dispensed at the stalls in the middle distance. The road leading to the wharves passes over the bridge at the left.

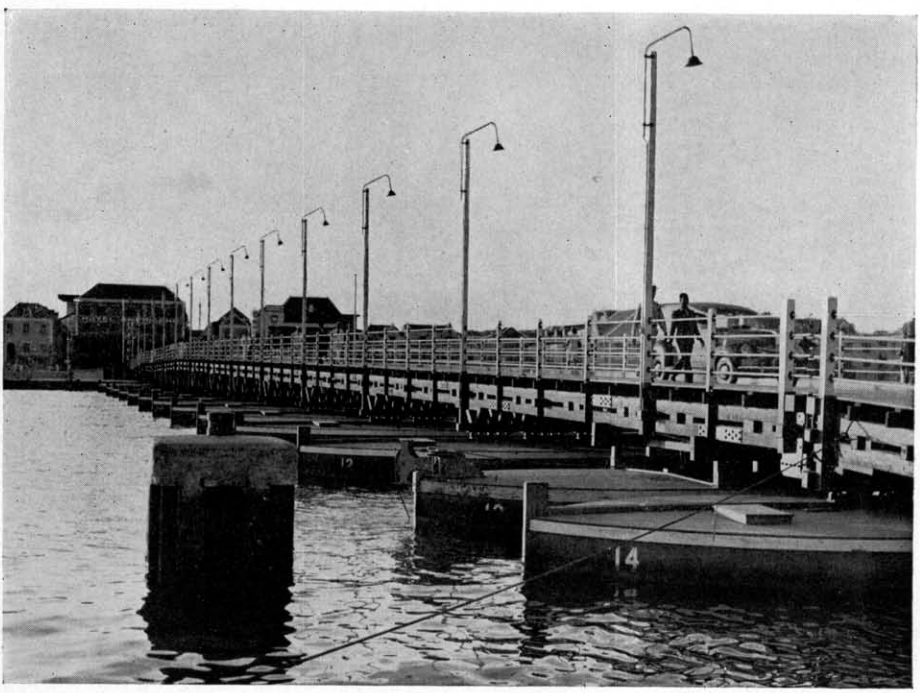
Fig. 18. Native canoes and small sailboats bring bananas, fish, and other wares to the large concrete building which houses the municipal market at Barranquilla.

PLATE 9

Fig. 19. Trio of three-masted schooners moored two abreast in front of Curaçao's most prosperous commercial houses.

Fig. 20. Pontoon bridge, known locally as "Queen Emma," carries two-way vehicular and pedestrian traffic. View looking west toward Hotel Americano.

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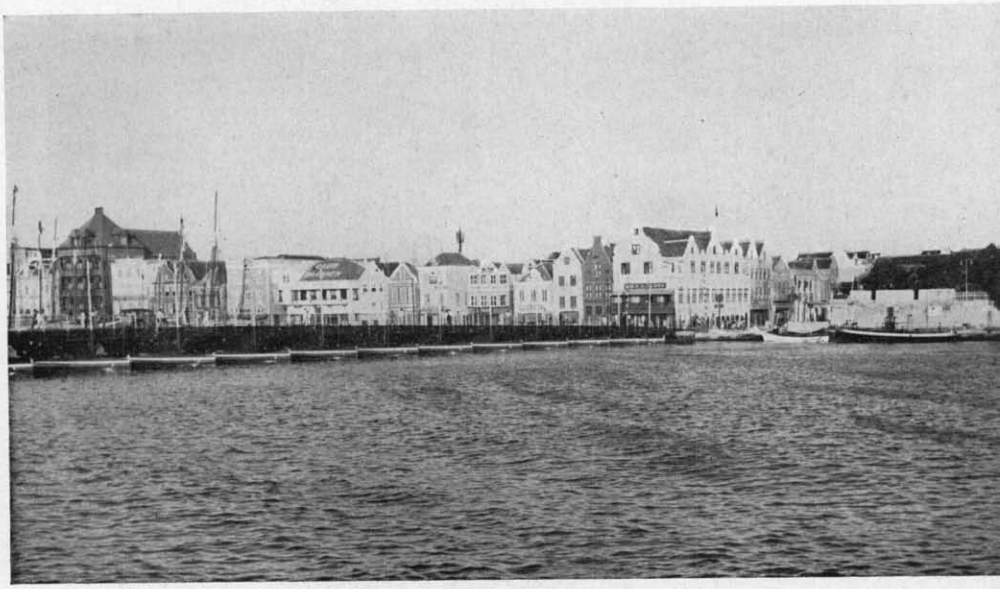
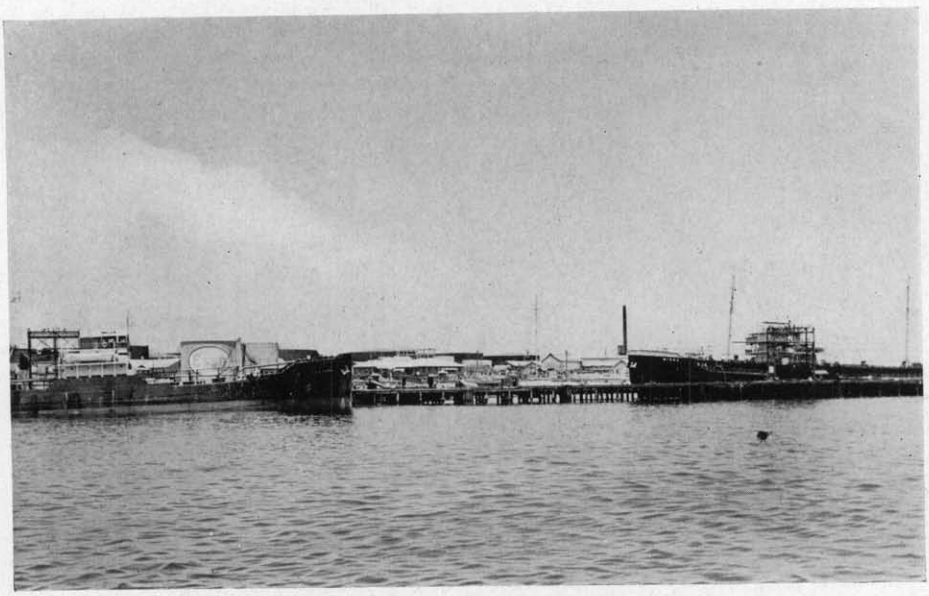


PLATE 10

Fig. 21. (Left half of a panorama of which Fig. 23 is the right.) View of Willemstad, Curaçao, taken from the west side of Santa Anna Harbor looking east. From left to right: pontoon bridge, business district, governor's house, and fort.

Fig. 22. Tankers loading oil at San Nicolaas Harbor, Aruba, Netherlands West Indies.



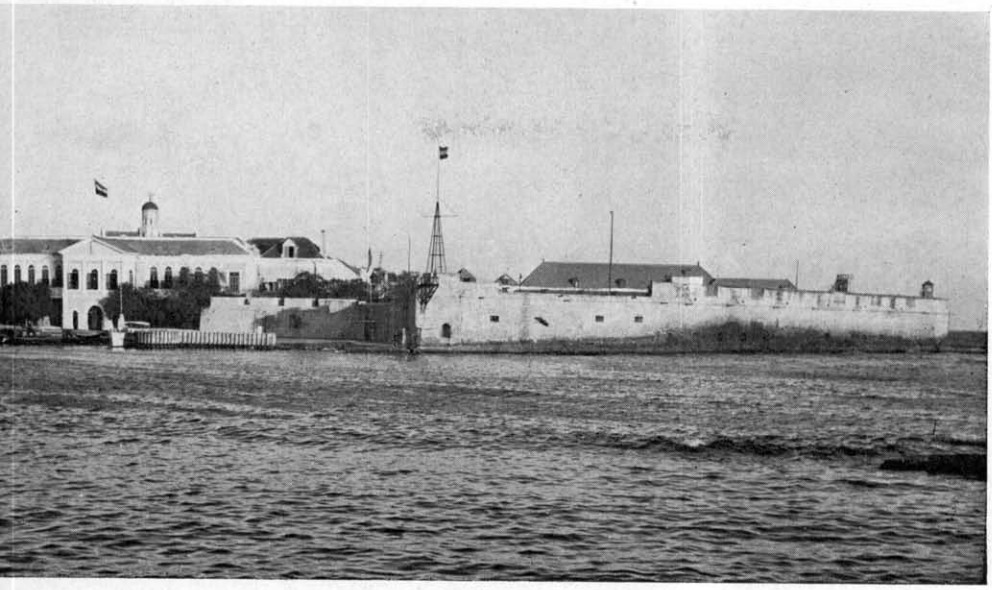


PLATE 11

Fig. 23. (Right half of a panorama of which Fig. 21 is the left. See explanation of Fig. 21.)

Fig. 24. View of Willemstad, Curaçao, looking south down Santa Anna Bay. From left to right: cargo vessel, commercial houses, trading schooners, government building, fortress, pontoon bridge, Dutch destroyer, small steamer.

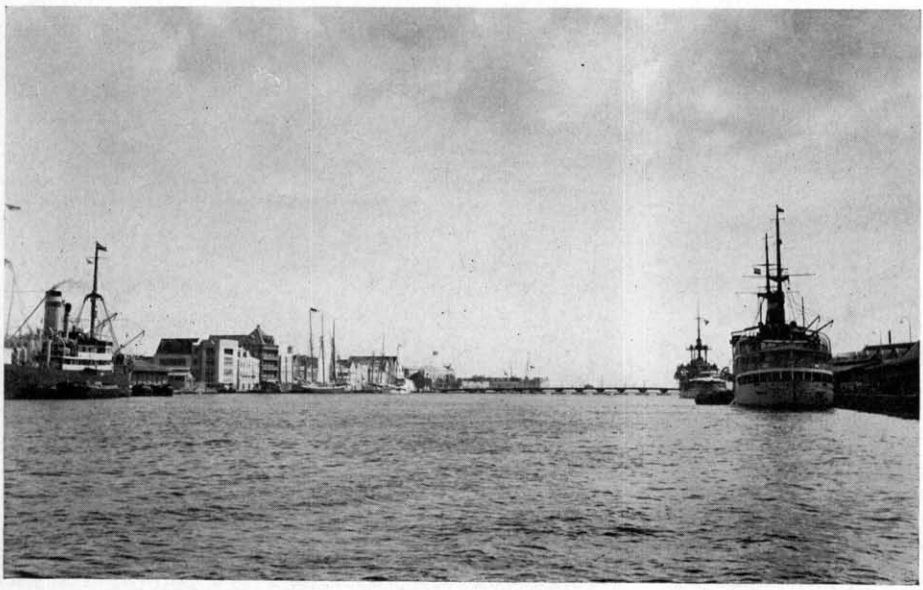
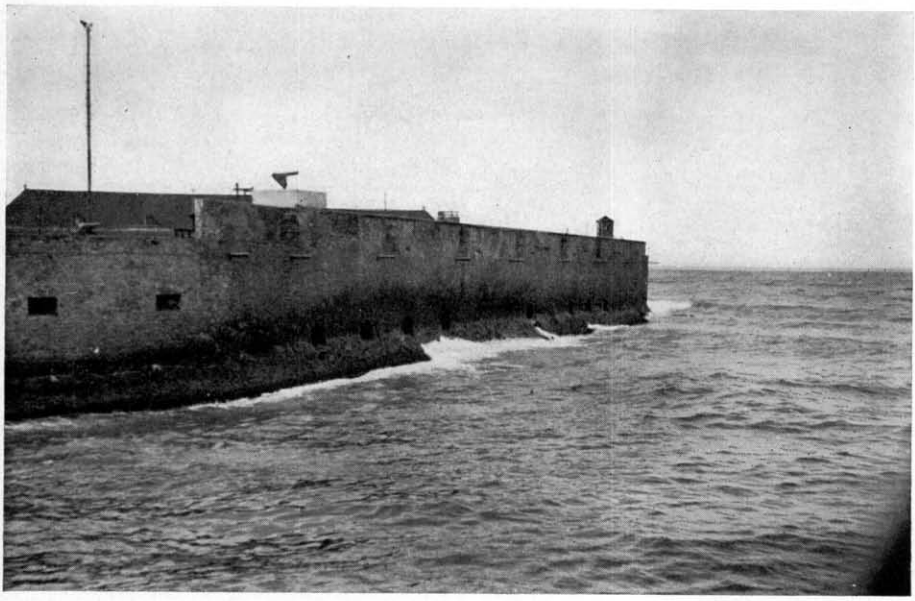


PLATE 12

Fig. 25. Fortification at the entrance to Santa Anna Bay, Curaçao. Gun emplacements and lookout tower may be clearly seen.

Fig. 26. Weather station atop a 200-foot promontory in Santa Anna Bay, Curaçao. From this vantage point signal flags are displayed to assist harbor traffic.



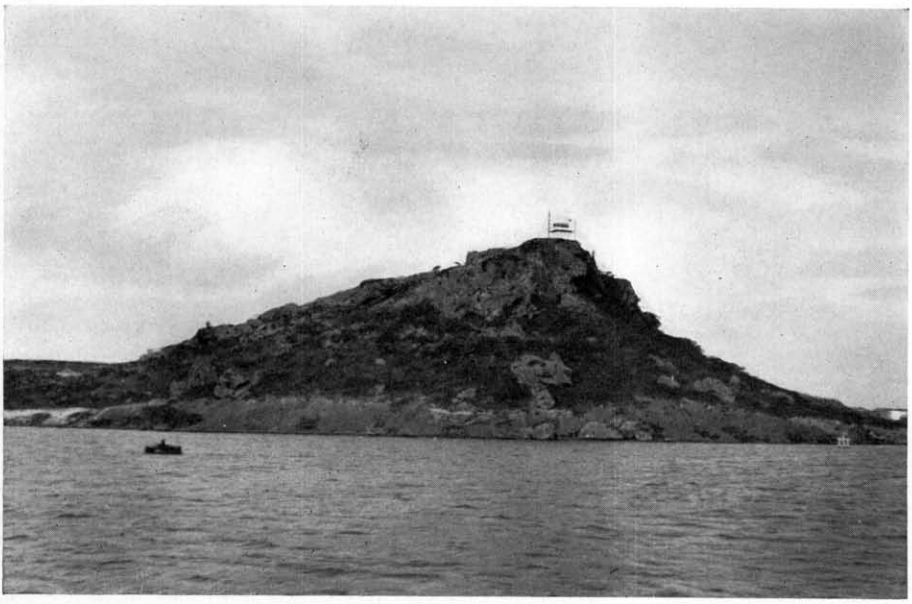


PLATE 13

Fig. 27. Oil storage tanks line the wharves at Santa Anna Bay, Curaçao. Some of the largest refineries in the world are located in the Netherlands West Indies.

Fig. 28. A view over the roof tops of Willemstad, Curaçao, toward the sea. The imposing structure to the left is the cathedral.

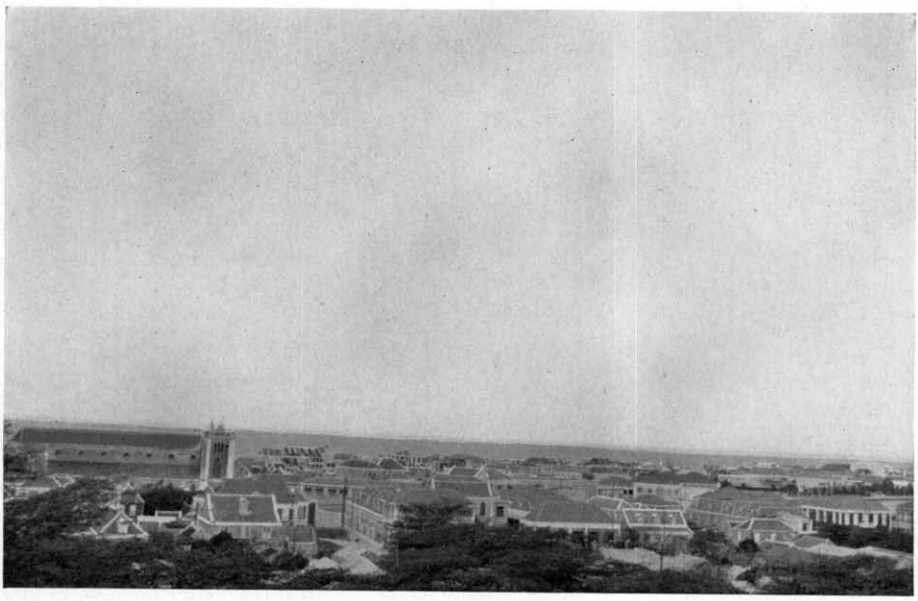


PLATE 14

Fig. 29. View along an inland waterway called the Waigaat, which separates the business and residential districts of Willemstad, Curaçao.

Fig. 30. Venezuelan trading vessels tied up alongside one of the principal streets of Willemstad. The island of Curaçao produces no fruits and vegetables and is dependent upon the South American mainland.

PLATE 15

Fig. 31. Scientists landing on Cubagua Island, Venezuela, preparatory to going inshore. (Figs. 31-36, Kodachromes.)

Fig. 32. Landing place at Cubagua Island, Venezuela, showing landing party beaching skiff.

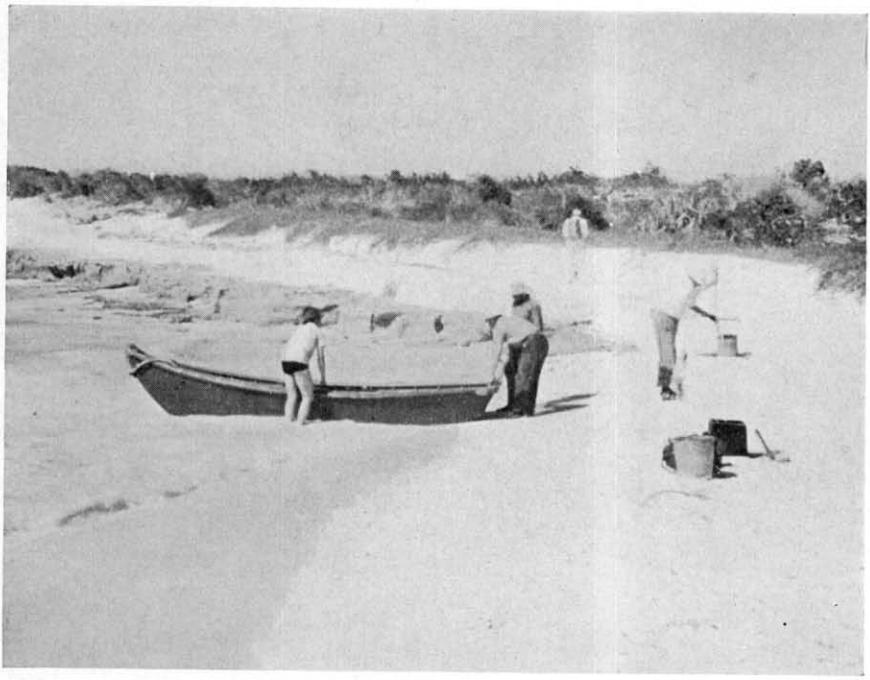
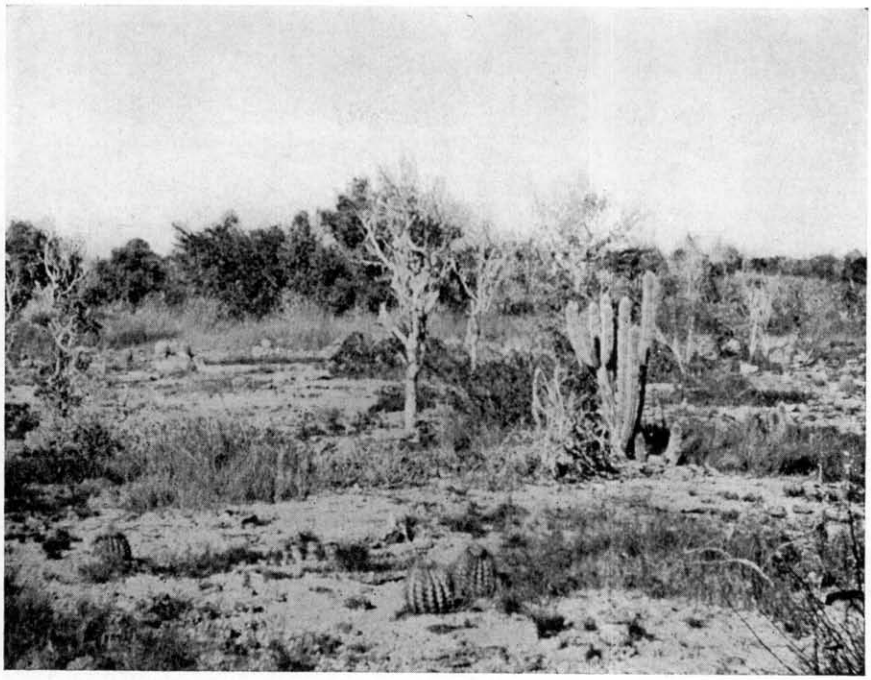


PLATE 16

Fig. 33. Interior of Cubagua Island, Venezuela, showing xerophytic vegetation, including barrel and branching cacti.

Fig. 34. West side of Cubagua Island, Venezuela, looking north. The beach is obviously rising



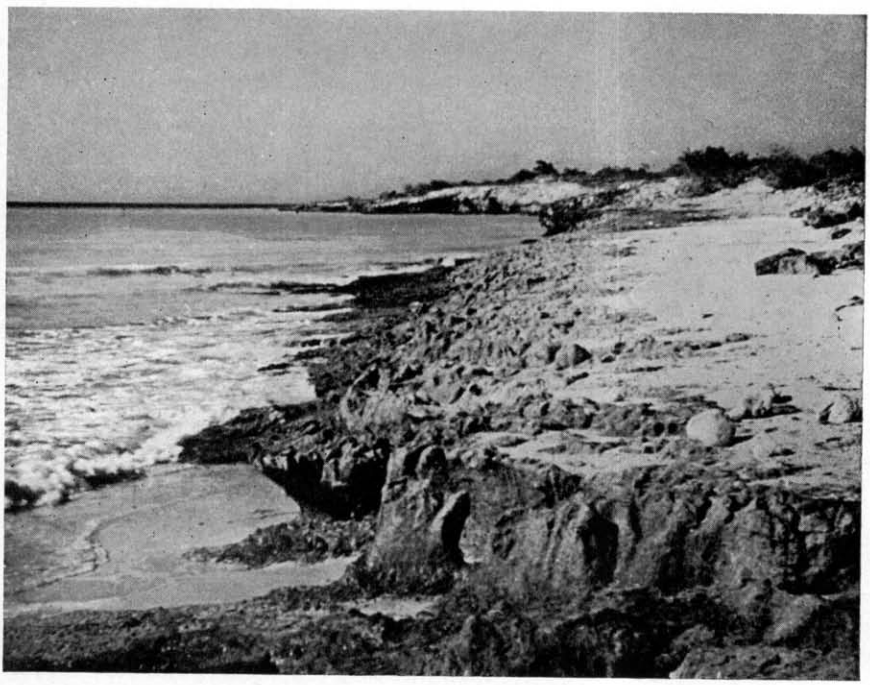


PLATE 17

Fig. 35. Shingle beach at Cubagua Island, Venezuela, composed of coral blocks.

Fig. 36. Marine zoologist at work on rocky shore of Cubagua Island, Venezuela.

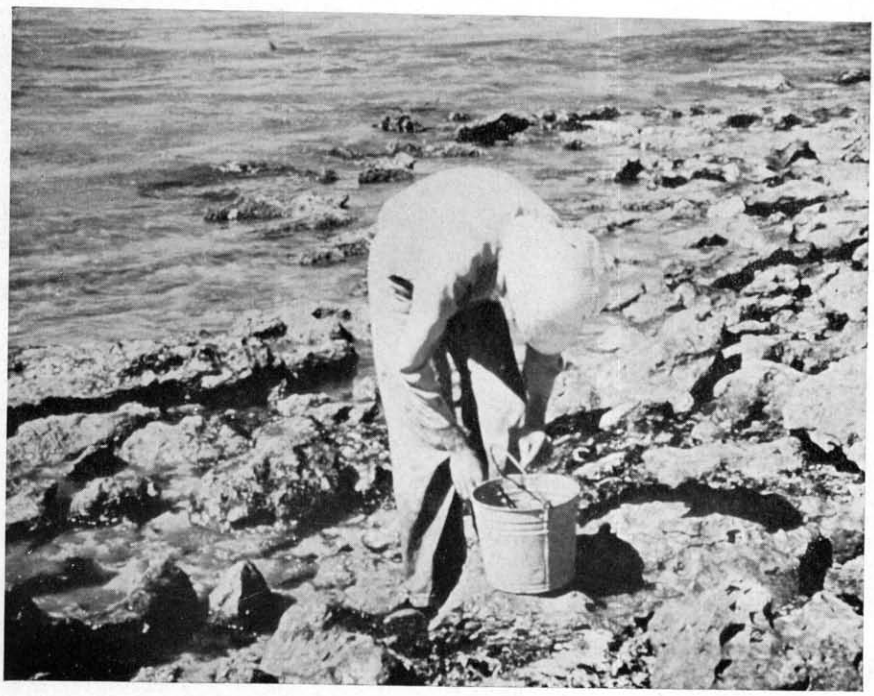
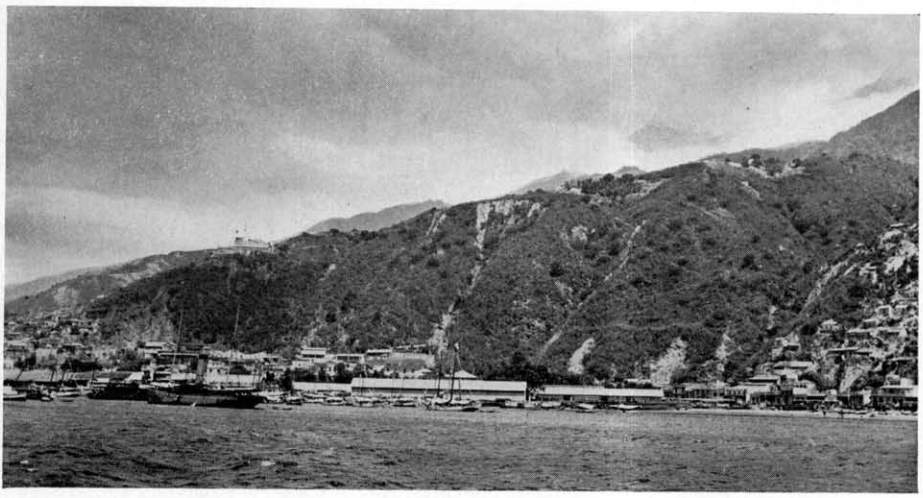


PLATE 18

Fig. 37. Inner harbor at La Guaira, Venezuela. Vessels anchor behind a breakwater out of sight at left of picture. Note warehouses along the shore and fortress on hilltop at left.

Fig. 38. Coche Island, Venezuela, as seen from the deck of the *Velero III*.

Fig. 39. Margarita Island, Venezuela, seen from the south during dredging operations in the channel between it and Cubagua and Coche islands.



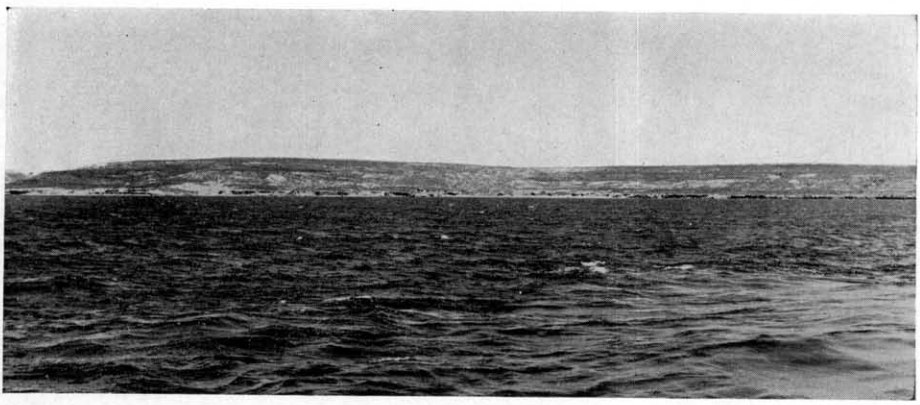


PLATE 19

Fig. 40. A portion of the city of La Guaira, Venezuela, seen from the anchorage. Mountains culminating in 7,000-foot summits rise behind the city.

Fig. 41. Looking shoreward from a point near the summit showing road and railroad which parallel each other between La Guaira and Caracas, the capital of Venezuela. The airline distance is about 9 miles.

PLATE 20

Fig. 42. Port of Spain, Trinidad, as seen from the *Velero III,* approaching from the northwest. The city fronts on the Gulf of Paria and is backed by St. Anne Peak.

Fig. 43. View from Port of Spain toward the Bocas del Dragon, or northern entrance to the Gulf of Paria, showing the Five Islands and Diego Islands against the northwest portion of Trinidad Island.

Fig. 44. Pitch Lake, Trinidad, from which comes most of the world's natural asphalt. Natives demonstrate the remarkable viscosity of the product.

PLATE 21

Fig. 45. Landing place at Scarborough, Tobago Island, as seen from offshore. (Figs. 45-50, Kodachromes.)

Fig. 46. Native boys assisting in the launching of a skiff, Scarborough, Tobago Island.

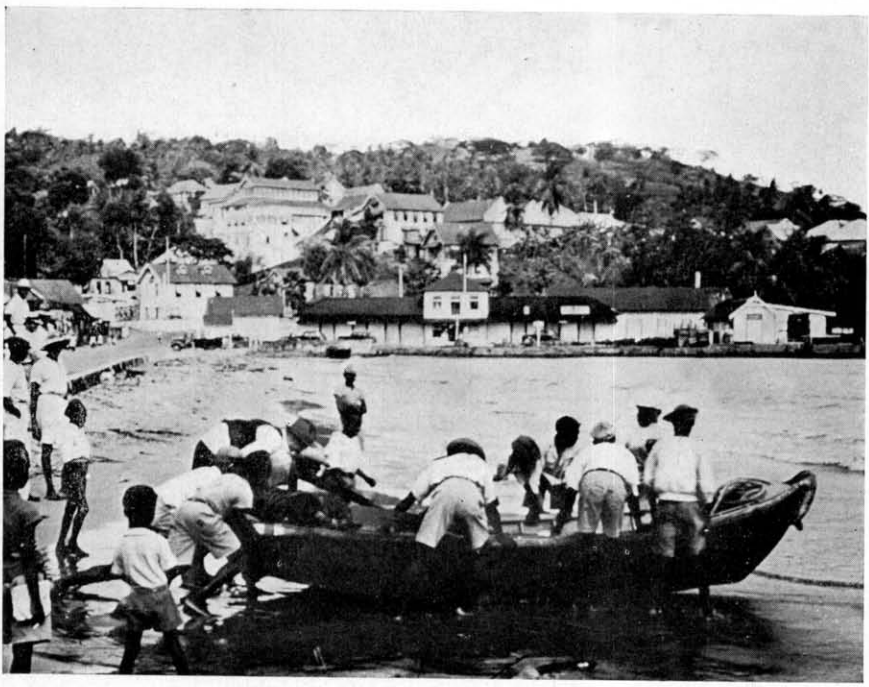


PLATE 22

Fig. 47. Buccoo Reef, off Buccoo Bay, Tobago Island, exposed at low tide.

Fig. 48. Marine zoologist cracking coral at Buccoo Reef, Tobago Island.

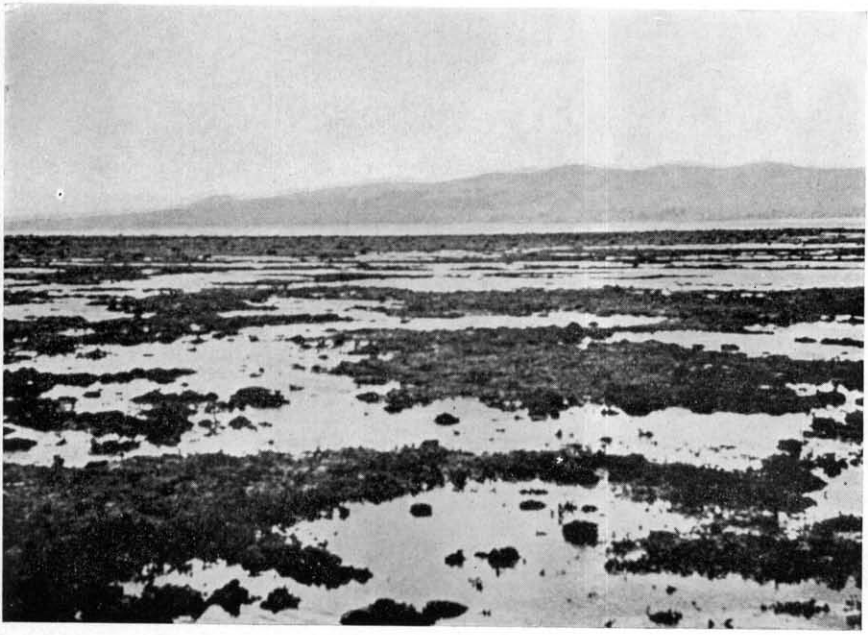


PLATE 23

Fig. 49. The beach at Great Courland Bay, Tobago Island.
Fig. 50. Palm-fringed beach at Great Courland Bay, Tobago Island.

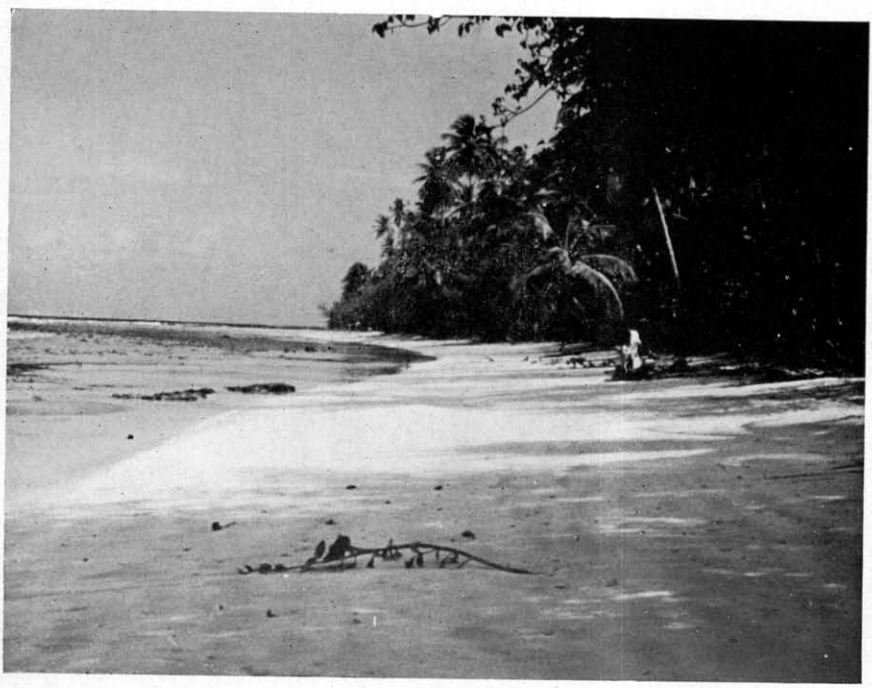


PLATE 24

Fig. 51. (Left half of a panorama of which Fig. 53 is the right half.) Northwest shore of Rockly Bay showing the village of Scarborough, the rolling hills of Tobago Island beyond and to the left. Ft. George is on the hill at the right.

Fig. 52. Expedition members arriving for beach seining at Buccoo Bay and for shore collecting on Buccoo Reef, and the station wagon in which they crossed Tobago Island from Scarborough.


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PLATE 25

Fig. 53. (Right half of a panorama of which Fig. 51 is the left half.)
Fig. 54. Expedition members, launching sailboat in which passage to Buccoo Reef was made, assisted by native boatmen.

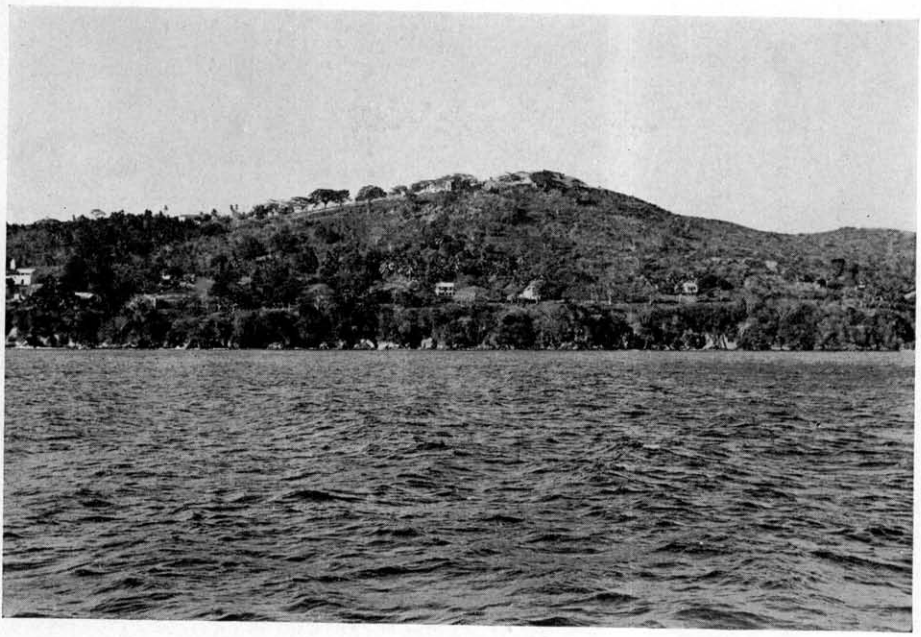
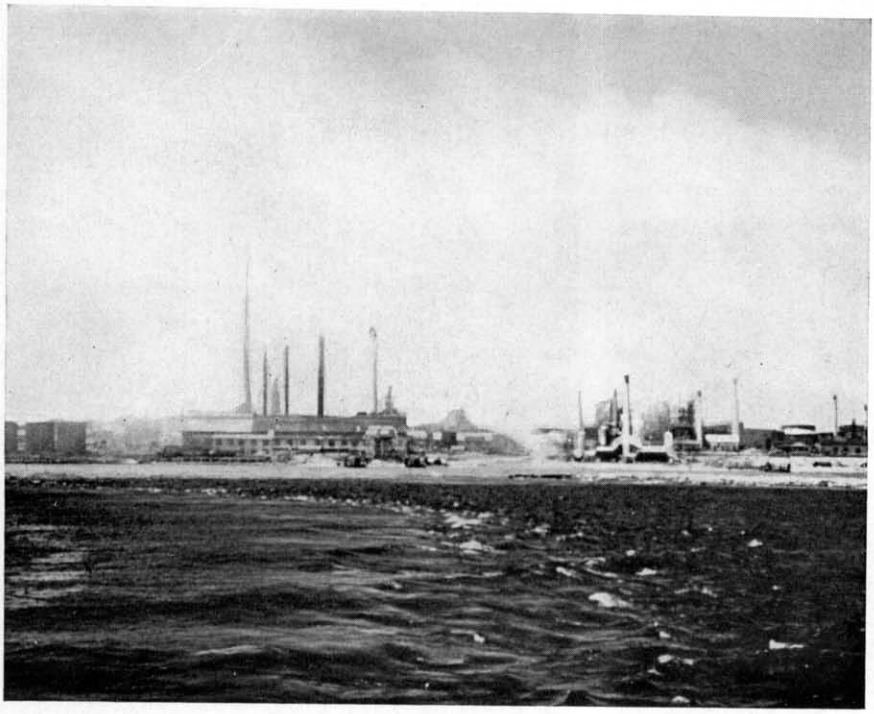


PLATE 26

Fig. 55. Oil refineries, Aruba, Netherlands West Indies. (Figs. 55-60, Kodachromes.)

Fig. 56. *Velero III* in the Schottegat, Curaçao, Netherlands West Indies.



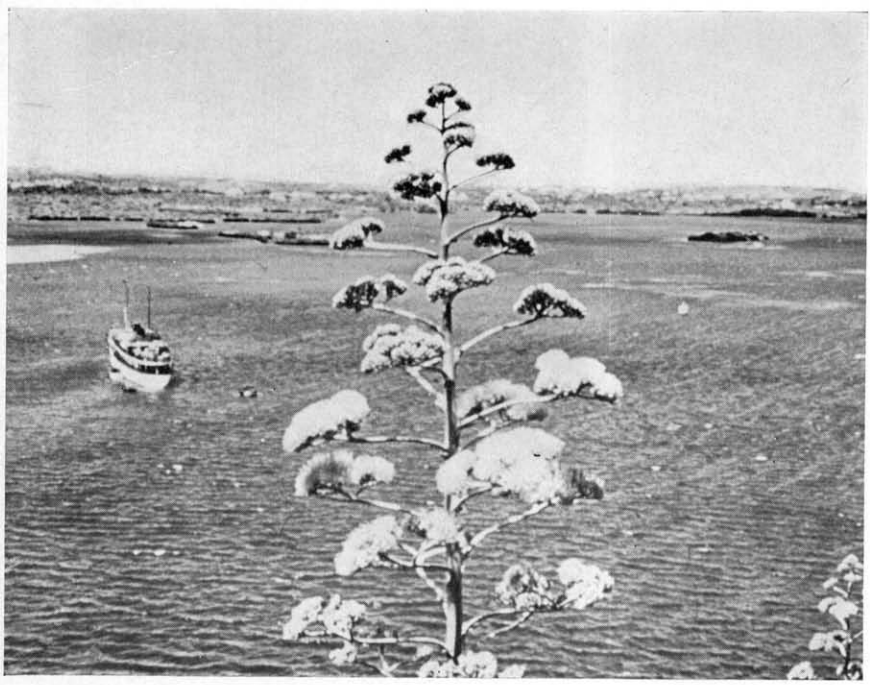


PLATE 27

Fig. 57. Wind-blown tree on the island of Aruba, Netherlands West Indies.
Fig. 58. Port of Spain, Trinidad, seen from the bridge of *Velero III*.

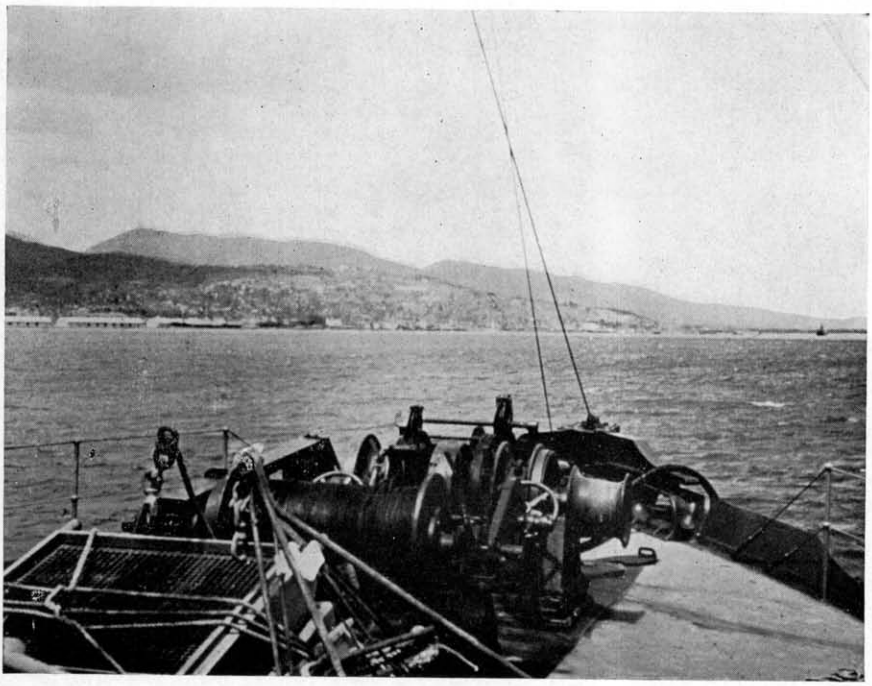
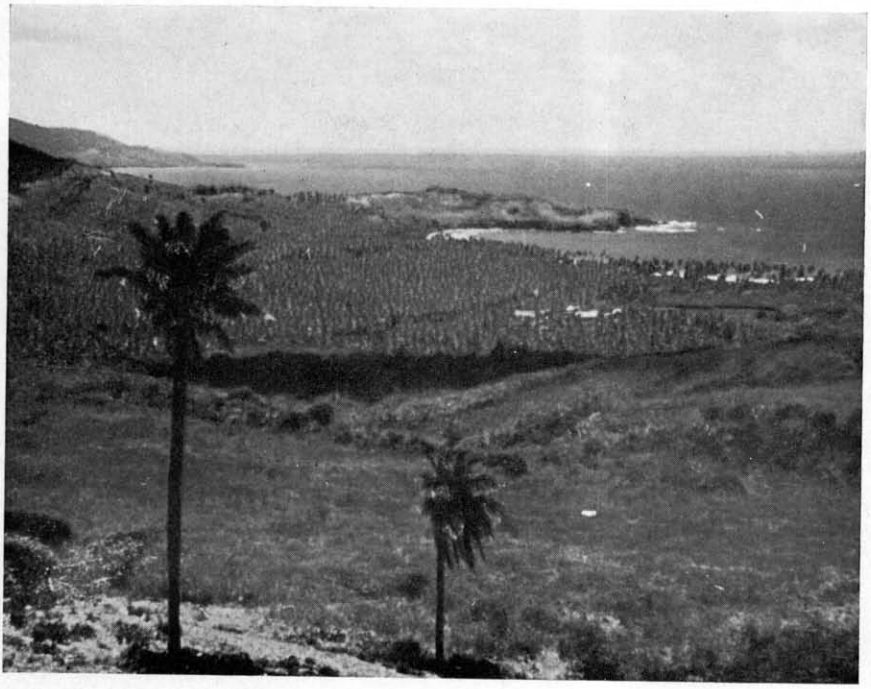


PLATE 28

Fig. 59. North shore of Tobago Island in the vicinity of Man-o'-War Bay.
Fig. 60. Port of Spain, Trinidad, as seen from a hill behind the city.



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